

BCI 3040 PULSE OXIMETER

OPERATION/SERVICE MANUAL



BCI INTERNATIONAL
W238 N1650 ROCKWOOD DRIVE
WAUKESHA, WI 53188-1199

CATALOG NUMBER 3050
VERSION 13, FEBRUARY 1995
©1988-1995, BCI INTERNATIONAL

Warranty & Service Information ***vii***

Proprietary Notice.....	vii
Limited Warranty	vii
Loaner Device	vii
Service Support.....	vii
Authorized Service Center.....	vii

Warnings, Cautions, & Notes ***viii***

Definitions	viii
Warnings.....	viii
Cautions.....	viii
Notes.....	ix

Chapter 1: Introduction ***1-1***

About this Manual.....	1-1
Oximeter Features	1-1
Theory of Operation	1-2
Pulse Oximetry Theory of Operation	1-2

Chapter 2: Operator's Instructions ***2-1***

Unpacking the Monitor	2-1
Unpacking the Monitor and Accessories.....	2-1
Powering the Monitor	2-2
Procedure.....	2-2
About the Monitor's Internal Battery	2-3
Attaching the Patient to the Monitor	2-4
Choose the Probe	2-4
Clean or Disinfect Reusable Probes.....	2-5
Attach the Probe to the Patient.....	2-5
Finger Probe for Adult or Pediatric Finger.....	2-5
Disposable Probe for Adult Finger or Toe.....	2-6
Disposable Probe for Pediatric Finger or Toe	2-6
Universal "Y" Probe for Adult or Pediatric Finger	2-7
Universal "Y" Probe for Infant Hand.....	2-7
Universal "Y" Probe for Infant Foot	2-7
Ear Clip for Adult or Pediatric Ear	2-8
Earprobe for Adult or Pediatric Ear	2-8
Wrap Probe for Infant Toe.....	2-9
Disposable Probe for Infant Finger or Toe	2-9
Disposable Probe for Neonate Hand or Foot	2-10

Wrap Probe for Neonate Foot	2-10
Attach Patient Cable to Monitor and to Probe	2-11
Attaching the Patient Cable	2-11
Procedure	2-11
Turning On the Monitor	2-12
Turning On The Monitor	2-12
Changing the SaO ₂ and Pulse Averaging Setting	2-12
Monitoring the Patient	2-13
Typical Display	2-13
SaO ₂ Value and Alarm Limits	2-13
Pulse Rate Value and Alarm Limits	2-13
Pulse Bar Graph	2-13
Pulse Beep (Not Shown)	2-13
Alarm and Alert Messages	2-13
ALARM SILENCED Message	2-13
Alarms, Alerts, and Messages	2-14
Alarms	2-14
Alarm Example	2-14
Alerts	2-15
CHECK SENSOR	2-15
PULSE SEARCH	2-15
Alert Example	2-15
Messages	2-16
LOW PULSE	2-16
LOW BATT	2-16
ALARM SILENCED	2-16
BEEP	2-16
BEEP SILENCED	2-16
ALARM	2-16
Changing the Monitor's Settings	2-17
Silencing the Alarm and Alert Tones	2-17
Indefinite	2-17
Two Minute	2-17
Canceling	2-17
Changing the Alarm and Alert Tone Volume	2-17
Changing the Pulse Beep Volume	2-17
Changing the Alarm Limits	2-18
Changing the Alarm Limits Example	2-18
Display Light	2-18
Turning Off the Monitor	2-18
Description of Controls and Features	2-19
Front Panel	2-19
SaO ₂ Value and Alarm Limits	2-19
Alarm Limit Indicators	2-19

Messages and Alerts	2-19
Pulse Bar Graph	2-19
Pulse Rate Value and Alarm Limits.....	2-19
CHG Indicator.....	2-20
ALARM Indicator	2-20
DISPLAY LIGHT Key	2-20
ALARM SELECT Key	2-20
▲ and ▼ keys.....	2-20
ALARM SILENCE Key	2-20
ON/OFF Key.....	2-20
Rear Panel	2-21
Power Supply Connector	2-21
Serial data connector.....	2-21
Patient cable or probe connector	2-21
Battery disconnect switch	2-21
Operator's Maintenance	2-22
Operator's Maintenance Schedule.....	2-22
Cleaning or Disinfecting the Monitor.....	2-22
Long-Term Storage Procedure.....	2-22
Operator's Troubleshooting Guide	2-23
Supplies and Accessories	2-25
3040 Oximeter Supplies and Accessories	2-25
3045 "Smart" Printer Supplies and Accessories	2-25
Ordering Information	2-25

Chapter 3: Using the Monitor with the 3045 "Smart" Printer **3-1**

Real-Time Printouts	3-1
Description	3-1
Data Log.....	3-1
Strip Chart	3-1
Snapshot	3-1
Trend Printouts	3-1
Description	3-1
Trend.....	3-1
Histogram	3-1
Spot Check.....	3-1
Connecting the Monitor to the Printer.....	3-2
Printer Menu	3-3
Setting the Printer's Time and Date	3-3
Scale Settings	3-4
Procedure for Setting Print Scales.....	3-4

Real-time printouts	3-5
Data Log Printout	3-5
Printing Instructions	3-5
Strip Chart Printout.....	3-6
Printing Instructions	3-6
Strip Chart and Trend Events Markers.....	3-7
Snapshot Printout.....	3-7
Printing Instructions	3-7
Trend Printouts	3-8
Description	3-8
Collecting Trend Data.....	3-8
Trend.....	3-8
Histogram	3-9
Spot Check.....	3-9
Procedure For Collecting Trends in the Printer	3-9
Procedure For Collecting Trends in the Monitor.....	3-10
Trend Printout	3-11
Printing Instructions	3-11
Histogram Printout.....	3-12
Printing Instructions	3-12
Spot Check Printout	3-13
Printing Instructions	3-13
Trend Reference Information	3-14
Trends Collected by the Printer	3-14
Trends Collected by the Monitor.....	3-15
Clearing Trends.....	3-16
Reasons to Clear the Trend Memory	3-16
To Clear the Printer's Trend Memory.....	3-16
To Clear the Monitor's Trend Memory	3-16
Downloading Trends.....	3-17
Trends Downloaded from the Monitor to the Printer	3-17
To Download Trends from the Monitor to the Printer	3-17

Chapter 4: Using the Monitor's Serial Port **4-1**

Serial Port Operating Modes	4-1
Description	4-1
Choosing the Operating Mode.....	4-1
Choosing the Printer Mode Example	4-1
Choosing the Data Line Mode Example.....	4-1
SERIAL DATA Connector Pinout and Interface.....	4-2
SERIAL DATA Connector Pinout and Interface Schematic	4-2
Interface Hardware Description	4-2
Communication Protocol	4-2
Data Line Mode.....	4-3
Data Line Mode Sample Output	4-3
Printer Mode	4-3
General Description.....	4-3
Commands and Response Formats	4-4
Commands	4-4
Responses	4-5
CONFIG Command	4-6

Chapter 5: Product Specifications **5-1**

Display	5-1
SaO ₂	5-1
Pulse Rate.....	5-1
Alarm Indicators	5-1
Alert Indicators	5-1
Messages.....	5-1
Compliance	5-1
Serial inputs/outputs.....	5-1
Power Requirements.....	5-1
Physical.....	5-1

Appendix A: Service Information **Appendix-1**

Circuit Board Test Points and Adjustments	Appendix-1
LCD Display Contrast	Appendix-1
Power Supply Checks	Appendix-1
Parts Lists, Drawings, and Schematics	Appendix-2
Parts lists	Appendix-2
Assembly Drawings	Appendix-2
Schematics	Appendix-2

Warranty & Service Information

Proprietary Notice

Information contained in this document is copyrighted by BCI International and may not be duplicated in full or part by any person without prior written approval of BCI International. Its purpose is to provide the user with adequately detailed documentation to efficiently install, operate, maintain and order spare parts for the device supplied. Every effort has been made to keep the information contained in this document current and accurate as of the date of publication or revision. However, no guarantee is given or implied that the document is error free or that it is accurate regarding any specification.

Limited Warranty

BCI International warrants each new device to be free from defects in workmanship and materials under normal use and service for a period of two (2) years from the date of shipment, and reusable probes for a period of six (6) months from shipment (domestic sales only). BCI International's sole obligation under this warranty will be to repair or replace, at its option, products that prove to be defective during the warranty period. The foregoing shall be the sole warranty remedy. Except as set forth herein, seller makes no warranties, either expressed or implied, including the implied warranties of merchantability and fitness for a particular purpose. No warranty is provided if the products are modified without the express written consent of BCI International, and seller shall not be liable in any event for incidental or consequential damage. This warranty is not assignable.

Loaner Device

BCI International will for the period of warranty make available at no charge, loaner devices if, in BCI International's opinion, the repair of the customer's device would require an unreasonable period of time.

Service Support

Repairs of BCI International's devices under warranty must be made at authorized repair centers. If the device needs repair, contact BCI International's service department to request a customer service report number (CSR). When calling, have the device's model and serial number ready.

NOTE: Shipments received without a CSR number will be returned to sender.

Authorized Service Center

BCI International
W238 N1650 Rockwood Drive
Waukesha, WI 53188-1199

Phone: (414) 542-3100
Toll-Free: (800) 558-2345
Fax: (414) 542-0718

Warnings, Cautions, & Notes

Warnings tell you about something that could hurt you or the patient.

Definitions

Cautions tell you about something that could damage the monitor.

Notes tell you important information.

Warnings



WARNING: Federal law (USA) restricts the use or sale of this device by, or on the order of, a physician.



WARNING: Do not use this device in the presence of flammable anesthetics.



WARNING: Reposition the probe at least once every 24 hours to allow the patient's skin to respire.



WARNING: When attaching probes with Microfoam®¹ tape, do not stretch the tape or attach the tape too tightly. Tape applied too tightly may cause inaccurate readings and blisters on the patient's skin (lack of skin respiration, not heat, causes the blisters).



WARNING: Do not use this equipment in the presence of magnetic resonance imaging (MR or MRI) equipment.



WARNING: Do not autoclave, ethylene oxide sterilize, or immerse this device in liquid. Unplug the AC charger from the device and from the wall outlet before cleaning or disinfecting.



WARNING: ELECTRICAL SHOCK HAZARD when covers are removed. Do not remove covers. Refer servicing to qualified personnel.



WARNING: Do not autoclave, ethylene oxide sterilize, or immerse the probes in liquid. Unplug the probes from the device before cleaning or disinfecting.

Cautions



CAUTION: This device is intended for use by persons trained in professional health care. The operator must be thoroughly familiar with the information in this manual before using the device.

¹Microfoam® is a registered trademark of the 3M Company.

Notes

NOTE: Operation of this device may be adversely affected in the presence of strong electromagnetic sources, such as electrosurgery equipment.

NOTE: Operation of this device may be adversely affected in the presence of computed tomograph (CT) equipment.

NOTE: Use only SaO_2 probes supplied with, or specifically intended for use with, this device.

NOTE: SaO_2 measurements may be adversely affected in the presence of high ambient light. Shield the probe area (with a surgical towel, for example) if necessary.

NOTE: Dyes introduced into the bloodstream, such as methylene blue, indocyanine green, indigo carmine, and fluorescein, may adversely affect the accuracy of the SaO_2 reading.

NOTE: Significant levels of dysfunctional hemoglobins, such as carboxyhemoglobin or methemoglobin, may affect the accuracy of the SaO_2 measurement.

NOTE: Any condition that restricts blood flow, such as use of a blood pressure cuff or extremes in systemic vascular resistance, may cause an inability to determine accurate pulse rate and SpO_2 readings.

NOTE: Remove fingernail polish or false fingernails before applying SpO_2 probes. Fingernail polish or false fingernails may cause inaccurate SpO_2 readings.

Chapter 1: Introduction

About this Manual...

The operator's instructions section provides installation, operation, and maintenance instructions. It is intended for health-care professionals trained in monitoring respiratory and cardiovascular activity.

The service information contains circuit test point and adjustments, detailed parts lists, mechanical drawings, and circuit diagrams. It is intended for persons trained in service, maintenance, and repair of modern medical devices. Thorough knowledge of this device's operation is required before attempting to repair this device.

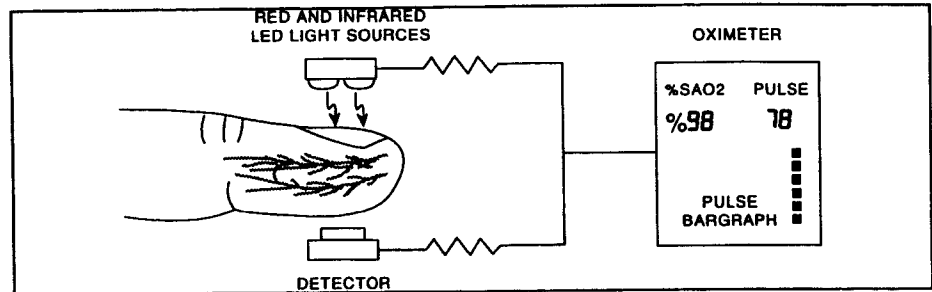
Oximeter Features

- Continuously and noninvasively monitors arterial blood oxygen saturation (SaO₂) and pulse rate for any patient, from neonates to adults.
- Continuously displays SaO₂, pulse rate, pulse strength, high and low alarm limits, and alarm and alert messages.
- Beeps with each pulse beat; the pitch of the pulse beep corresponds to the SaO₂ value.
- High and low alarm limits, alarm and alert tone volume, and pulse beep volume are all user-adjustable.
- Portable, compact, and lightweight.
- Ideally suited for use in intensive care units, in outpatient clinics, in emergency rooms, or during emergency air or land transport.
- Operates on power from its internal rechargeable battery or the AC line.
- Optionally connects to an external printer for real-time or trend printouts. Up to nine hours of data from multiple patients can be collected and printed.
- Serial input/output connector provides data line and printer mode outputs. In data line mode, measured values and events data are output in ASCII once per second. In printer mode, SaO₂, pulse rate, signal strength, plethysmogram, status indication, alarm settings, and trend data are sent to the host in response to single character commands. These are useful for capturing and analyzing patient measurements on computer systems.

Theory of Operation

The oximeter determines SaO_2 and pulse rate by passing two wavelengths of light, one red and one infrared, through body tissue to a photodetector. During measurement, the signal strength resulting from each light source depends on the color and thickness of the body tissue, the probe placement, the intensity of the light sources, and the absorption of the arterial and venous blood (including the time varying effects of the pulse) in the body tissues.

Pulse Oximetry Theory of Operation



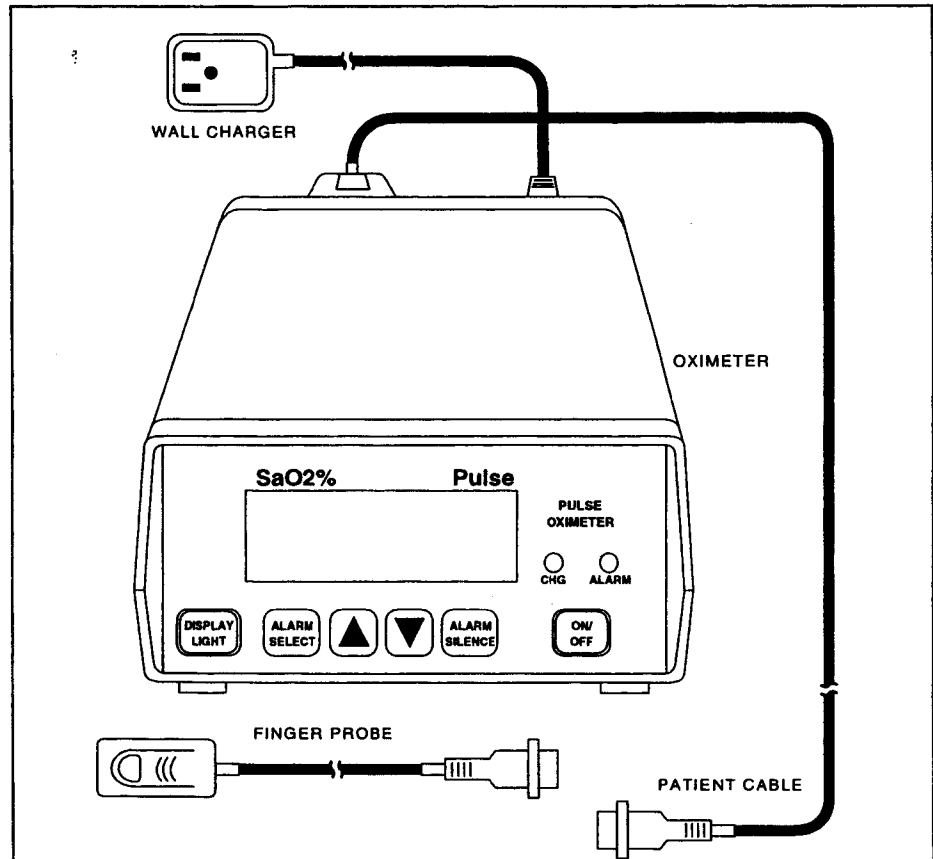
The oximeter processes these signals, separating the time invariant parameters (tissue thickness, skin color, light intensity, and venous blood) from the time variant parameters (arterial volume and SaO_2) to identify the pulse rate and calculate oxygen saturation. Oxygen saturation calculations can be performed because oxygen saturated blood predictably absorbs less red light than oxygen depleted blood.

Chapter 2: Operator's Instructions

Unpacking the Monitor

Carefully remove the oximeter and its accessories from the shipping carton. Save the packing materials in case the oximeter must be shipped or stored. Compare the packing list with the supplies and equipment you received to make sure you have everything you'll need.

Unpacking the Monitor and Accessories

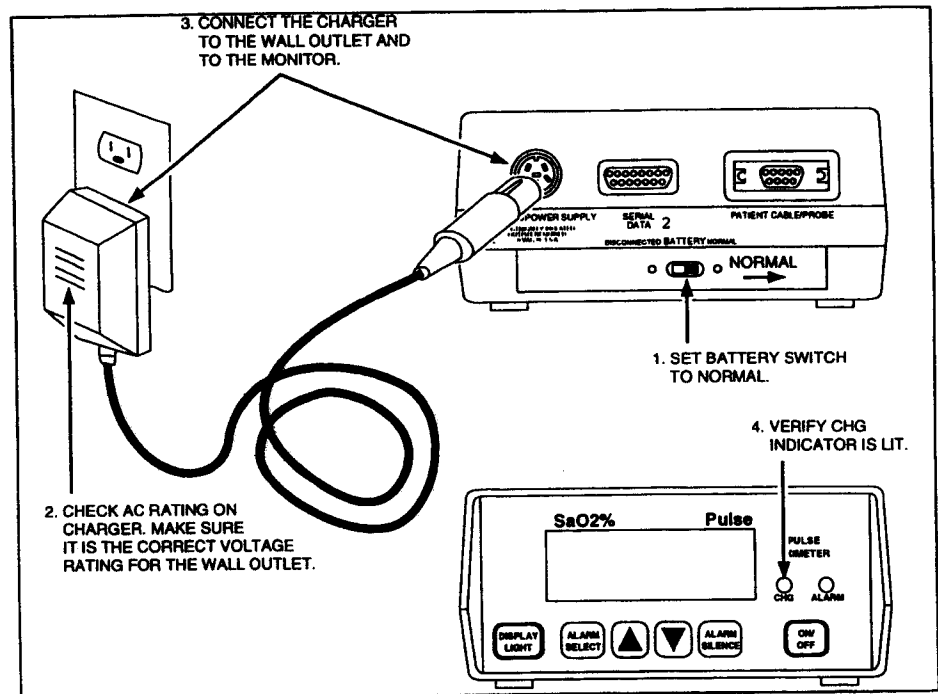


Powering the Monitor

The monitor is powered from its internal rechargeable battery or from the AC line. Whenever possible, power the monitor from the AC line. This ensures the battery will be fully charged for use during a power outage or other emergency.

To operate the monitor from its internal battery, do step 1 in the following procedure. To operate the monitor from the AC line and to charge the internal battery, do steps 1-4 in the following procedure.

Procedure



1. Check the BATTERY switch on the monitor's rear panel. Set this switch to NORMAL for charging or to power the monitor from the internal battery.
2. Check the AC voltage rating on the charger. Make sure it is the same voltage rating as the wall outlet at your installation site.



CAUTION: If the AC voltage rating on the charger does not match the AC line voltage at your installation site, do not use the monitor. Contact your authorized service center for help.

3. Connect the charger to the wall outlet and to the monitor.
4. Make sure the front panel CHG indicator is lit. If the CHG indicator is not lit, repeat steps 1-3 above. If the CHG indicator still does not light, contact your authorized service center for help.

About the Monitor's Internal Battery Here are several things you need to know about the monitor's internal battery.

Charge the monitor's internal battery:

- when the monitor's LOW BATT message is displayed.
- after you've operated the monitor from its internal battery.
- when you've just received the monitor from shipping.
- when you've just received the monitor from long-term storage.

The monitor's internal battery will fully charge in about:

- ten hours if the monitor is turned off.
- twenty hours if the monitor is turned on.

A fully-charged battery provides twelve to sixteen hours of continuous use, depending on the operating conditions. For example, turning off the display light saves battery power and provides the longest possible battery use time.

Attaching the Patient to the Monitor

Attaching the patient to the monitor requires four steps:

1. Choose the probe.
2. Clean or disinfect the probe if you've chosen the reusable type. (Disposable probes do not require cleaning or disinfecting.)
3. Attach the probe to the patient.
4. Attach the probe's connector to the oximeter or to the patient cable.

Each of these steps is described in the following sections.

Choose the Probe

Choose the appropriate probe from the following chart.

Patient	Site	Description	Page
Adult > 45 Kg	Finger	#3044: Probe, Adult	10
		#3043: Probe, Universal "Y"	12
	Finger or Toe	#1300: Probe, Disp., Adult Finger	11
	Ear	#3042: Clip, Ear (use with universal "Y" probe)	13
		#3078: Probe, Ear	13
Pediatric 15-45 Kg	Finger	#3044: Probe, Adult	10
		#3043: Probe, Universal "Y"	12
	Finger or Toe	#1301: Probe, Disp., Ped. Finger	11
	Ear	#3042: Clip, Ear (use with universal "Y" probe)	13
		#3078: Probe, Ear	13
Infant 3-15 Kg	Hand or Foot	#3043: Probe, Universal "Y"	12
	Toe	#3025: Probe, Wrap, Infant	14
	Finger or Toe	#1303: Probe, Disp., Infant	14
Neonate < 3 Kg	Hand or Foot	#1302: Probe, Disp., Neonate	15
	Foot	#3026: Probe, Wrap, Neonate	15

**Clean or Disinfect
Reusable Probes**

Clean or disinfect reusable probes before attaching to a new patient.



WARNING: Do not autoclave, ethylene oxide sterilize, or immerse the probes in liquid. Unplug the probes from the monitor before cleaning or disinfecting.

Clean the probe with a soft cloth moistened in water or a mild soap solution. To disinfect the probe, wipe the probe with isopropyl alcohol.

**Attach the Probe to the
Patient**

Attach the probe to the patient as shown in the following illustrations.



WARNING: Reposition the probe at least once every twenty-four (24) hours to allow the patient's skin to respire.

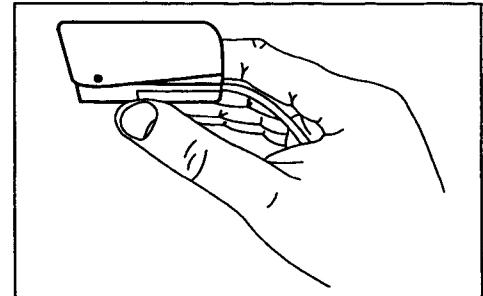


WARNING: When attaching probes with Microfoam® tape, do not stretch the tape or attach the tape too tightly. Tape applied too tightly may cause inaccurate readings and blisters on the patient's skin (lack of skin respiration, not heat, causes the blisters).

NOTE: Remove fingernail polish or false fingernails before applying SaO₂ probes. Fingernail polish or false fingernails may cause inaccurate SaO₂ readings.

***Finger Probe for Adult or
Pediatric Finger***

Attach the finger probe to the patient as shown. Be sure to fully insert the patient's finger into the probe. For patients with long fingernails, use the universal "Y" probe.

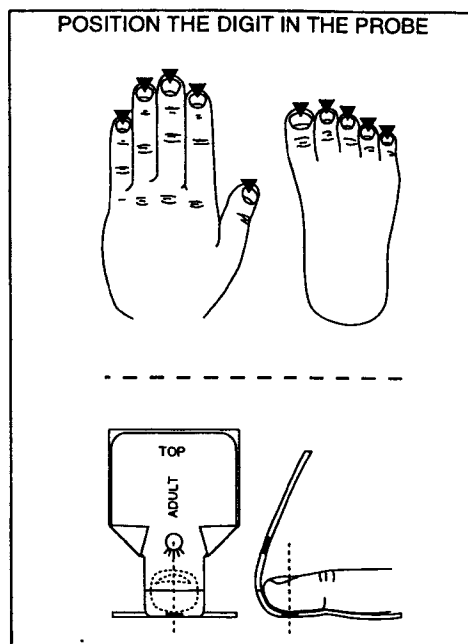


*Disposable Probe for
Adult Finger or Toe*

*Disposable Probe for
Pediatric Finger or
Toe*

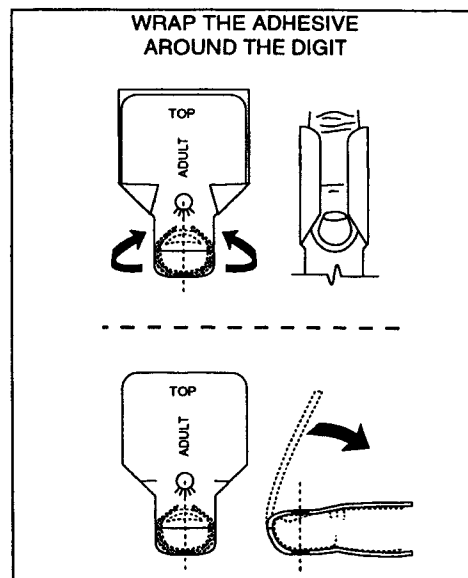
Choose an application site on the patient's finger or toe where the light source will be directly over and in-line with the detector. The preferred sites are the forefinger or the thumb.

Place the patient's digit in the probe nail-side up, lining up the digit's pad over the detector. The probe's positioning line runs across the fingertip.



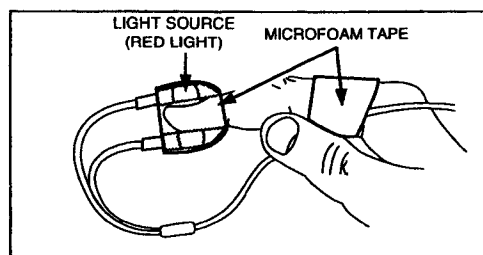
Wrap the bottom adhesive around the digit, being careful not to cover the nail.

Fold the probe's top over the digit, making sure the light source is directly over and in-line with the detector. Wrap the adhesive around the finger or toe to secure the probe. Route the cable along the palm or the bottom of the foot, and secure with adhesive tape if necessary.



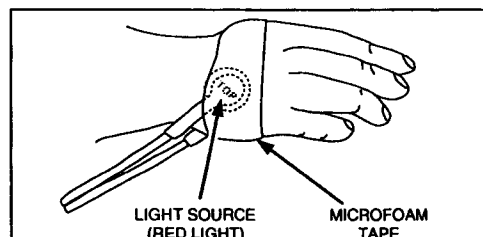
*Universal "Y" Probe
for Adult or Pediatric
Finger*

Attach the probe to the patient with the light source to the fingernail. Line up the light source with the detector, so the source and detector are in-line. Secure the probe and cable with Microfoam® tape, being careful not to over-tighten the tape.



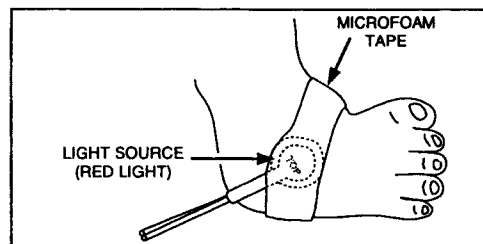
*Universal "Y" Probe
for Infant Hand*

Attach the Universal Y probe to a fleshy portion of the infant's hand. Attach the probe with the light source on the outside or top of the hand to keep the detector away from ambient light. Line up the light source with the detector, so the source and detector are in-line. Secure the probe with Microfoam® tape, being careful not to over-tighten the tape.



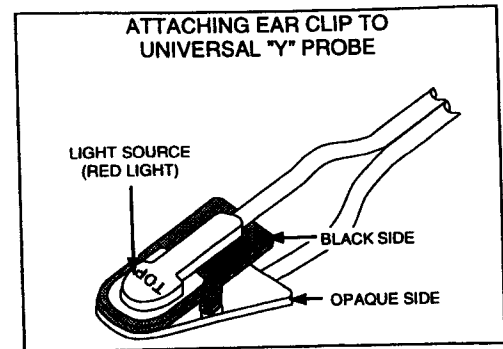
*Universal "Y" Probe
for Infant Foot*

Attach the probe to a fleshy portion of the infant's foot. Attach the probe with the light source on the outside or top of the foot to keep the detector away from ambient light. Line up the light source with the detector, so the source and detector are in-line. Secure the probe with Microfoam® tape, being careful not to over-tighten the tape.

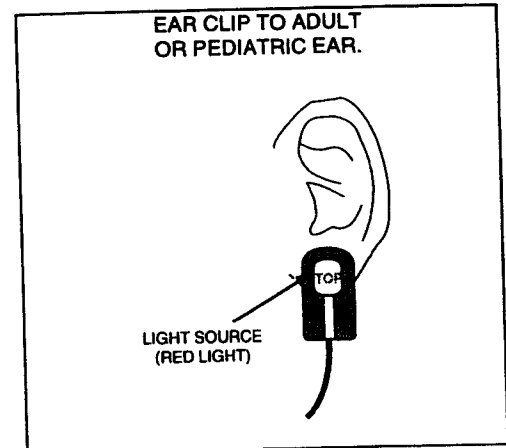


***Ear Clip for Adult
or Pediatric Ear***

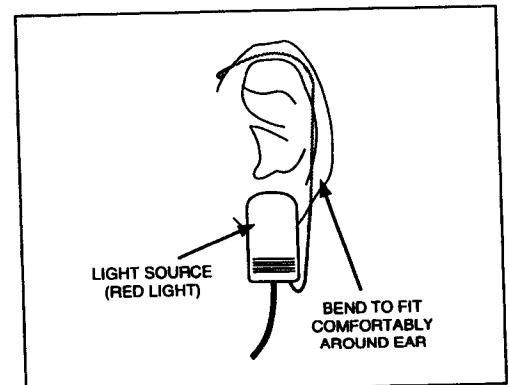
Attach the ear clip to the universal "Y" probe by sliding the probe's light source into the ear clip's black side and the probe's detector into the ear clip's opaque side.



Rub the patient's earlobe with an alcohol prep for 1-2 minutes. Then attach the probe and ear clip to a fleshy portion of the patient's earlobe. Make sure the light source is on the outside of the ear.

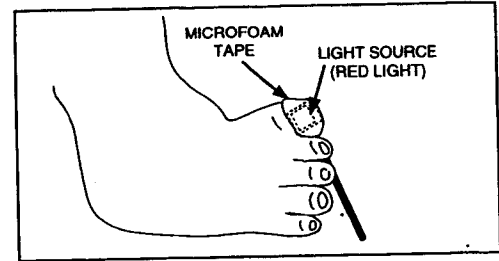
***Earprobe for Adult
or Pediatric Ear***

Rub the patient's earlobe with an alcohol prep for 1-2 minutes. Attach the ear probe to a fleshy portion of the earlobe. Make sure the light source is on the outside of the ear, and the hanger is behind the ear. Bend the hanger to comfortably fit the patient's ear.

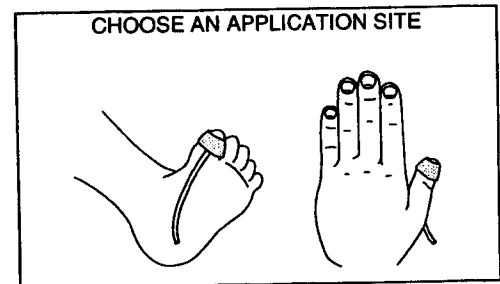


**Wrap Probe
for Infant Toe**

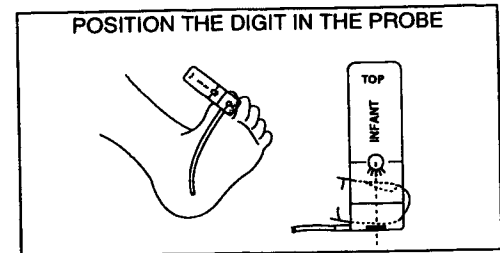
Attach the infant wrap probe with the light source to the toenail. Attach the probe with the light source on the outside or top of the foot to keep the detector away from ambient light. Line up the light source with the detector, so the source and detector are in-line. Secure the probe with Microfoam® tape, being careful not to over-tighten the tape.

**Disposable Probe for
Infant Finger or Toe**

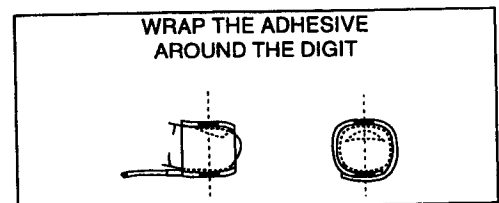
Choose an application site on the patient's hand or foot. The preferred site is the infant's great toe. Alternatively, the thumb or another large digit can be used.



Place the probe on the infant's digit. Position the detector on the digit's pad and line-up the light source with the detector.

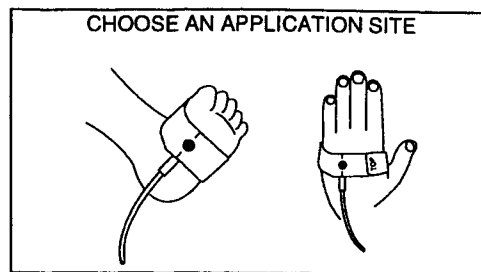


Wrap the adhesive around the digit. Be sure to line-up the light source with the detector as shown. Secure the cable to the foot or hand using adhesive tape if necessary.

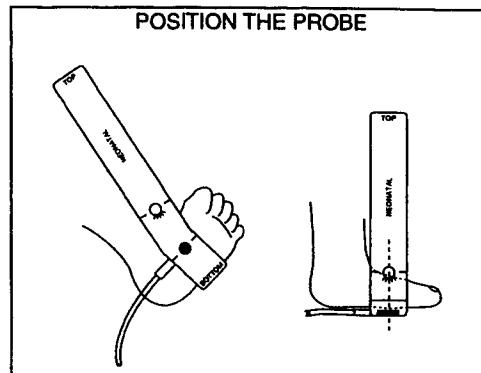


Disposable Probe for Neonate Hand or Foot

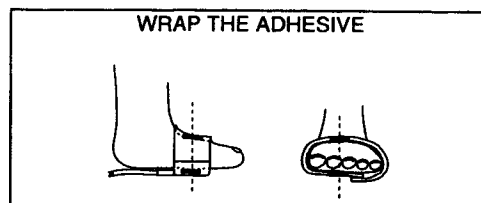
Choose an application site on the patient's foot or hand. The preferred site is the ball of the foot. Alternatively, the heel of the hand can be used.



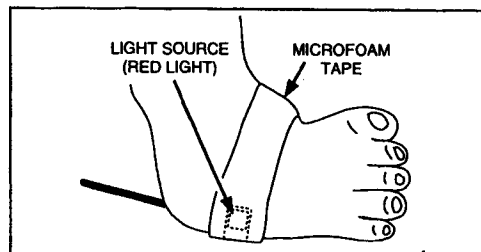
Position the detector on the sole of the foot or heel of the hand. Route the cable towards the heel or wrist. Line-up the light source with the detector.



Wrap the adhesive around the foot or hand. Be sure to line-up the light source with the detector as shown. Secure the cable to the foot or hand using adhesive tape if necessary.

*Wrap Probe for Neonate Foot*

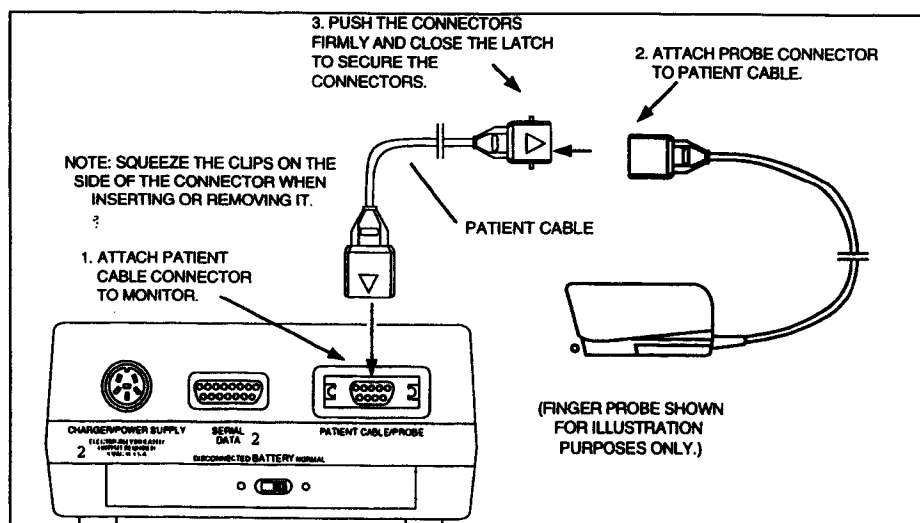
Attach the neonatal wrap probe to a fleshy portion of the foot. Attach the probe with the light source on the outside or top of the foot to keep the detector away from ambient light. Line up the light source with the detector, so the source and detector are in-line. Secure the probe with Microfoam® tape, being careful not to over-tighten the tape.



Attach Patient Cable to Monitor and to Probe

Attaching the Patient Cable

The following illustration and procedure shows you how to attach the patient cable to the monitor and to the probe.



- Procedure
1. Attach the patient cable connector to the **PATIENT CABLE/PROBE** connector on the rear panel of the monitor. Note that squeezing the clips on the side of the connector help when inserting (or removing) the connector.
 2. Attach the probe connector to the patient cable connector.
 3. Connect the probe to the patient cable as shown. Push the connectors firmly and close the latch to secure the connectors.

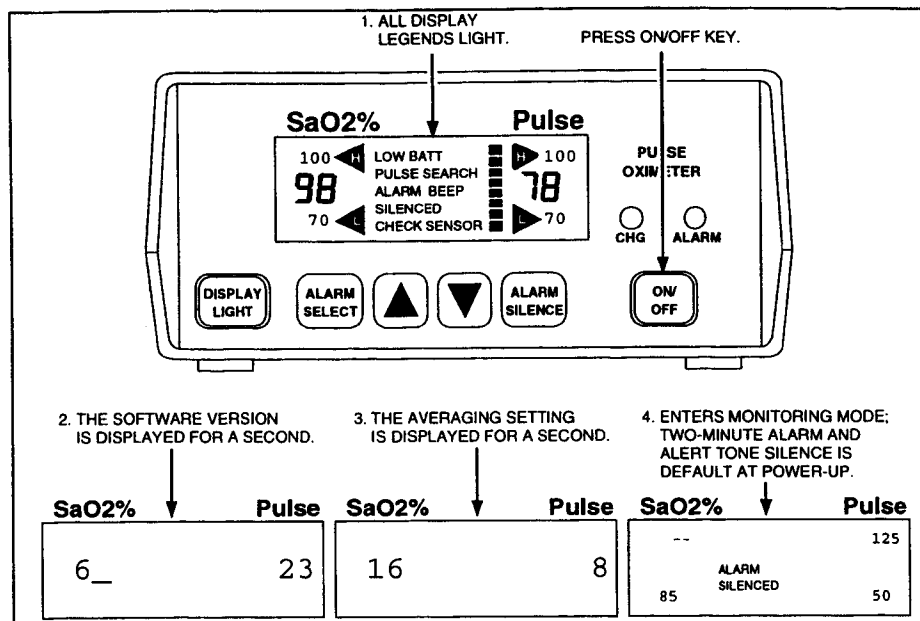
NOTE: The probe connector is normally attached to the patient cable, but it can also be attached directly to the monitor. To do this, simply attach the probe's connector directly to the **PATIENT CABLE/PROBE** connector on the monitor.

Turning On the Monitor

To turn on the monitor, press the front panel ON/OFF key. When turned on, the monitor does the following:

1. All of the display legends light for a second.
2. The monitor's installed software version is displayed for a second.
3. The monitor's averaging setting is displayed for a second.
4. The monitor automatically enters the monitoring mode; alarm and alert tones are silenced for two minutes.

Turning On The Monitor



Changing the SaO₂ and Pulse Averaging Setting

The monitor has available four averaging settings for SaO₂ and pulse. SaO₂ averaging is the number of pulse beats over which the SaO₂ value is averaged; pulse averaging is the number of seconds over which the pulse value is averaged.

To change the averaging setting, press and hold the appropriate front panel key while turning on the monitor, as shown in the following chart. (Note that the averaging setting is retained when the monitor is turned off.)

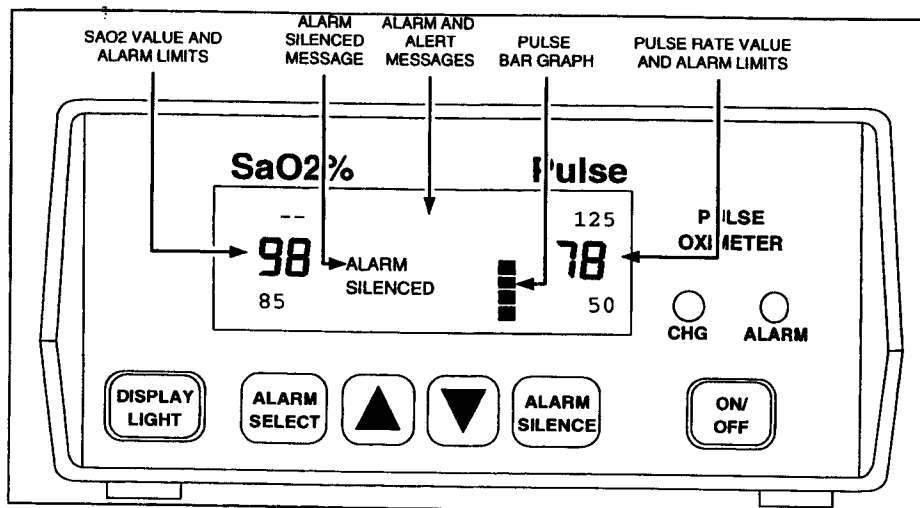
Power-up key press	SaO ₂ averaging	Pulse averaging
▲	16	16
▼	4	8
ALARM SILENCE	16	8
ALARM SELECT	8	8

Monitoring the Patient

A few seconds after the monitor is turned on, the SaO_2 and pulse rate values and the pulse bar graph should be shown. If not, make sure the probe is properly positioned on the patient and that all of the connectors are tight. If the values are still not shown, see the *Operator's troubleshooting guide* section.

The following illustration shows a typical display while monitoring a patient.

Typical Display



SaO₂ Value and Alarm Limits The SaO₂ value, in percent, is shown on the left side of the display. Notice that the high alarm limit (-- in this example) is shown above the value and the low alarm limit (85 in this example) is shown below the value.

Pulse Rate Value and Alarm Limits The pulse rate value, in beats per minute (BPM), is shown on the right side of the display. Notice that the high alarm limit (125 in this example) is shown above the value and the low alarm limit (50 in this example) is shown below the value.

Pulse Bar Graph The vertical pulse bar graph has eight segments to show the patient's pulse activity and strength. The bar graph is logarithmically scaled to indicate a wide range of pulse strengths.

Pulse Beep (Not Shown) An audible pulse beep sounds with each pulse beat. The pitch of the pulse beep is determined by the SaO₂ value. The higher the SaO₂ value, the higher the pulse beep pitch. Conversely, the lower the SaO₂ value, the lower the pulse beep pitch.

Alarm and Alert Messages Messages related to the patient and to the monitor are shown in this area of the display. For details, see the *Alarms, alerts, and messages* section.

ALARM SILENCED Message ALARM SILENCED flashes while the alarm and alert tones are silenced for two minutes and lights steady while the alarm and alert tones are silenced indefinitely. For details, see the *Silencing the alarm and alert tones* section.

Alarms, Alerts, and Messages

Alarms

An alarm warns you when a patient's measurement matches or is outside the high or low alarm limits for that measurement. For example, if the low SaO₂ alarm limit is set to 85, and the patient's measured SaO₂ is 85 or less, an alarm is triggered. During an alarm:

- The ALARM indicator flashes.
- The alarm tone sounds (siren), if it is not silenced.
- The alarm limit indicator for the violated alarm limit flashes.

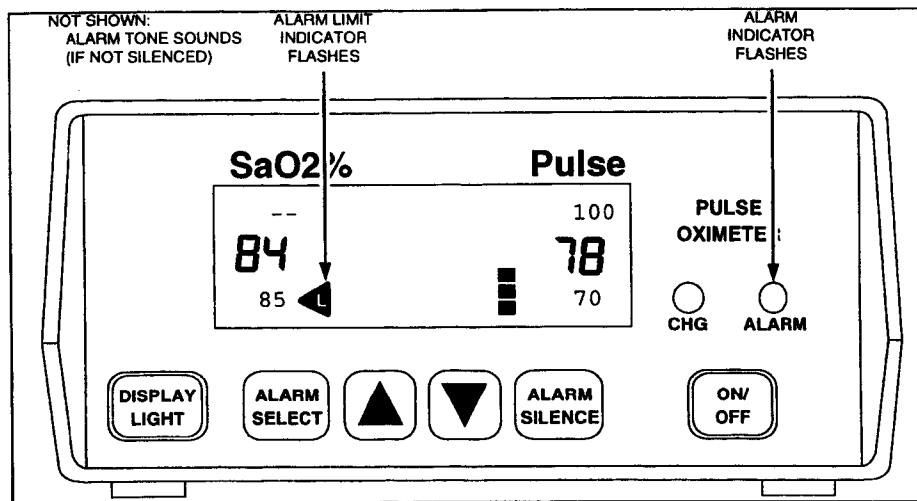
There are four possible alarm conditions:

- High SaO₂
- Low SaO₂
- High Pulse
- Low Pulse

Note that the alarm conditions will occur for both the SaO₂ and the rate measurements if both are violated at the same time.

The following illustration shows a typical display during an alarm.

Alarm Example



Alerts

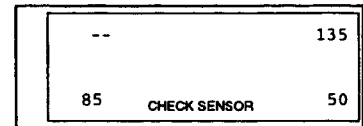
An alert warns you about a condition that prevents the monitor from taking a measurement. For example, if the SaO₂ probe is not connected to the monitor, the monitor cannot measure the patient's SaO₂ or pulse rate. In this case, an alert is triggered. During an alert:

- The ALARM indicator lights steady.
- The alert tone sounds (beep-beep), if it is not silenced.
- A message describing the alert is displayed.

There are two possible alerts:

- CHECK SENSOR
- PULSE SEARCH

CHECK SENSOR The CHECK SENSOR alert means the probe is not attached to the patient or the probe is not connected to the monitor. To correct the CHECK SENSOR alert: make sure the patient cable and probe connectors are firmly seated; make sure the probe is properly positioned on the patient.

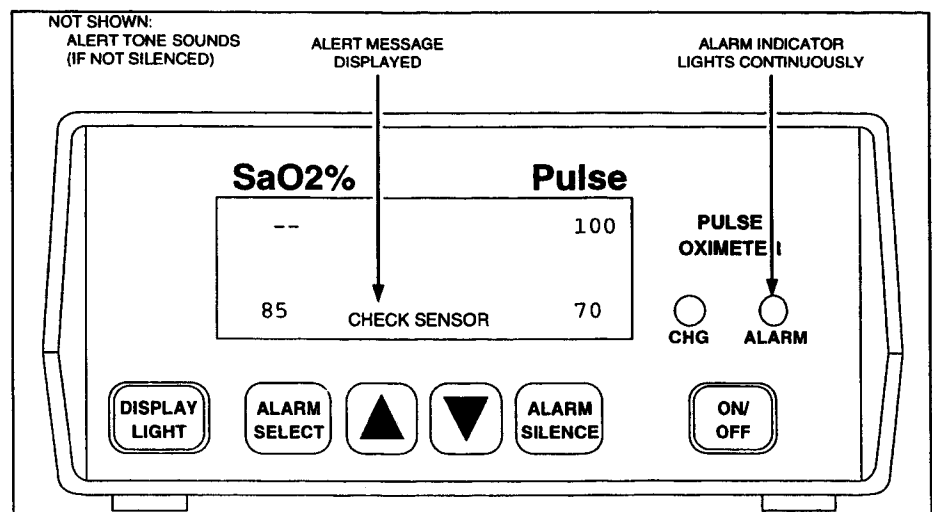


PULSE SEARCH PULSE SEARCH is displayed while the oximeter circuitry is attempting to measure the patient's SaO₂ and pulse. If after fifteen seconds the oximeter was unable to determine the SaO₂ and pulse values, the PULSE SEARCH alert is activated. To correct the alert, make sure the probe is properly positioned on the patient.



The following illustration shows a typical display during an alert.

Alert Example

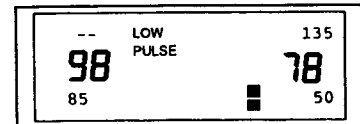


Messages

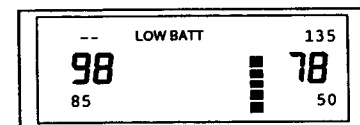
Messages are displayed to inform you of a condition (for example, ALARM SILENCED) or to inform you that the monitor requires your attention (for example, LOW BATT). Messages are shown in the middle portion of the display. These are the possible messages:

- LOW PULSE
- LOW BATT
- ALARM SILENCED
- BEEP
- BEEP SILENCED
- ALARM

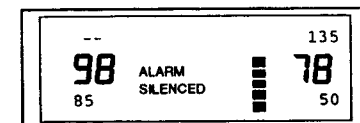
LOW PULSE The LOW PULSE message means the measured pulse strength is low (two or fewer bars in the pulse bargraph). If this message persists, make sure the probe is properly positioned on the patient or position the probe on another site.



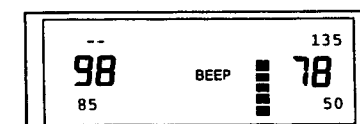
LOW BATT The LOW BATT message means the monitor's internal battery needs charging. When LOW BATT is first displayed, a series of short beeps is sounded. For charging instructions, see the *Powering the monitor* section.



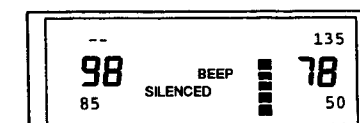
ALARM SILENCED When ALARM SILENCED is flashing, the alarm and alert tones are silenced for two minutes. When ALARM SILENCED is lit steady, the alarm and alert tones are silenced *indefinitely* (until the ALARM SILENCE key is pressed or until the monitor is turned off). See also *Silencing the alarm and alert tones*.



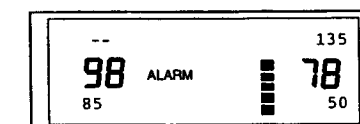
BEEP BEEP is displayed while you are adjusting the pulse beep volume. See also *Changing the pulse beep volume* section.



BEEP SILENCED BEEP SILENCED is momentarily displayed when the pulse beep volume is adjusted to off. See also *Changing the pulse beep volume* section.



ALARM ALARM is displayed while you are adjusting the alarm and alert tone volume. See the *Changing the alarm and alert tone volume* section.



Changing the Monitor's Settings

This section tells you how to:

- Silence the alarm and alert tones.
- Change the alarm and alert tone volume.
- Change the pulse beep volume.
- Change the alarm limits.
- Turn on and off the display light.
- Turn off the monitor.

Silencing the Alarm and Alert Tones

The alarm and alert tones are silenced for two minutes when the monitor is turned on. ALARM SILENCED flashes during the two minute time-out.

- | | |
|------------|--|
| Indefinite | To silence the alarm and alert tones <i>indefinitely</i> (until the ALARM SILENCE key is momentarily pressed or until the monitor is turned off), press and hold ALARM SILENCE for about three seconds. ALARM SILENCED lights steady on the display when the alarm and alert tones are silenced indefinitely. |
| Two Minute | To silence the alarm and alert tones for two minutes, momentarily press ALARM SILENCE. If alarms were already silenced, you must momentarily press ALARM SILENCE again (the first press cancels the alarm silence condition, the second press silences the alarms for two minutes). ALARM SILENCED flashes during the two minute time-out. |
| Canceling | To cancel either the two minute or the indefinite alarm silenced condition, momentarily press ALARM SILENCE; ALARM SILENCED turns off. |

Changing the Alarm and Alert Tone Volume

Follow these steps to change the alarm and alert tone volume:

1. Make sure the ALARM SILENCED message is not shown on the display (neither flashing nor lit steady). If ALARM SILENCED is shown on the display, press ALARM SILENCE to cancel the alarm silenced condition.
2. To adjust up or down the alarm and alert tone volume, press the ▲ or ▼ keys; the alarm tone sounds at the new volume as you are setting it. You can also press and hold the ▲ or ▼ keys to quickly "scroll" to the volume you want. The message ALARM is shown while you are adjusting the volume.

Changing the Pulse Beep Volume

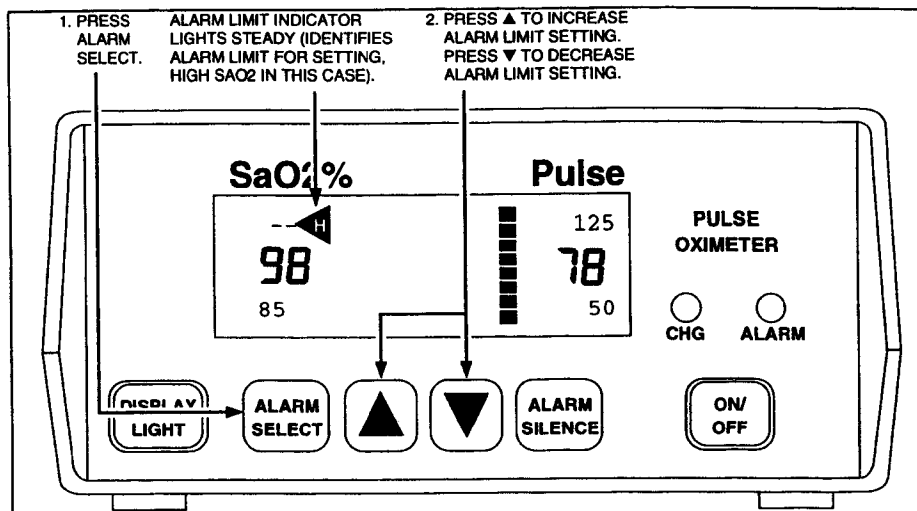
Follow these steps to change the pulse beep volume:

1. Make sure the ALARM SILENCED message is shown on the display (either flashing or lit steady). If ALARM SILENCED is not shown on the display, press ALARM SILENCE.
2. To adjust up or down the pulse beep volume, press the ▲ or ▼ keys; the pulse beep sounds at the new volume as you are setting it. You can also press and hold the ▲ or ▼ keys to quickly "scroll" to the volume you want. The message BEEP is shown while you are adjusting the volume. The message BEEP SILENCED is displayed for a few seconds if you adjust the pulse beep volume to off.

Changing the Alarm Limits

1. Press ALARM SELECT until the alarm limit indicator lights next to the limit you want to set.
2. To adjust up or down the alarm limit, press the ▲ or ▼ keys. You can also press and hold the ▲ or ▼ keys to quickly "scroll" to the setting you want.

Changing the Alarm Limits Example



NOTE: "---" in the alarm limit display means the limit is set to off.

NOTE: Alarm limits are non-overlapping; that is, you cannot set the high alarm limit equal to or lower than the low alarm limit and you cannot set the low alarm limit equal to or higher than the high alarm limit.

3. Repeat steps 1 and 2 until you've adjusted all of the alarm limits you want.
4. If you don't press any keys for about 20 seconds, you will automatically leave the alarm limit setting mode. Otherwise, to leave the alarm limit setting mode press ALARM SELECT until none of the alarm limit indicators are lit steady.

NOTE: Alarms are not active while you are setting alarm limits; however, alarms are active as soon as you leave the alarm limit setting mode. Alerts are active while you are setting the alarm limits.

Display Light

The display light enhances the display's readability. Pressing the DISPLAY LIGHT key turns on or off the display light.

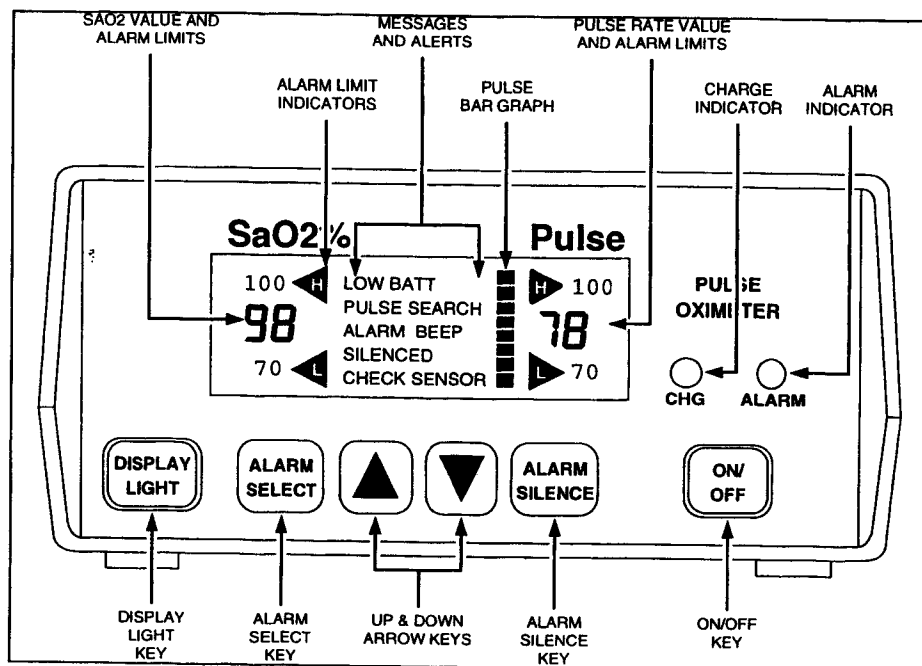
NOTE: When you are using the monitor under battery power, turning off the display light increases the battery use time.

Turning Off the Monitor

Press the front panel ON/OFF key to turn off the monitor.

Description of Controls and Features

Front Panel

***SaO₂ Value and Alarm Limits***

The patient's measured SaO₂ value is shown in large digits on the display. The SaO₂ display is blank if the measurement is invalid or unavailable.

The high SaO₂ alarm limit is shown above the SaO₂ value; the low SaO₂ alarm limit is shown below the SaO₂ value. Dashes (--) in the alarm limit indicate the limit is set to off.

Alarm Limit Indicators

The alarm limit indicators serve two purposes: they flash when the corresponding alarm limit is violated; they light steady to indicate the corresponding alarm limit is ready for changing.

Messages and Alerts

Messages and alerts are shown in this area of the display. For details on the displayed messages and alerts, see the *Alerts* section and the *Messages* section.

Pulse Bar Graph

The vertical pulse bar graph has eight segments to show the patient's pulse activity and strength. The bar graph is logarithmically scaled to indicate a wide range of pulse strengths.

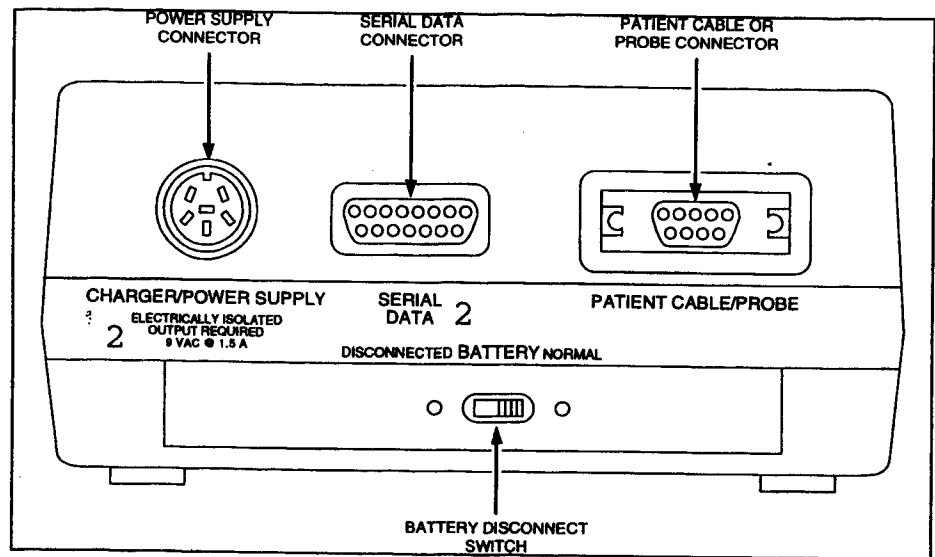
Pulse Rate Value and Alarm Limits

The patient's measured pulse rate value is shown in large digits on the display. The pulse rate display is blank if the measurement is invalid or unavailable.

The high pulse rate alarm limit is shown above the pulse rate value; the low pulse rate alarm limit is shown below the pulse rate value. Dashes (--) in the alarm limit indicate the limit is set to off.

- CHG Indicator** The CHG indicator lights when the internal battery is charging. See also *Powering the monitor*.
- ALARM Indicator** The ALARM indicator serves two purposes: it flashes during an alarm and it lights steady during an alert. See the *Alarms, alerts, and messages* section.
- DISPLAY LIGHT Key** The DISPLAY LIGHT key turns on or off the display light.
- ALARM SELECT Key** The ALARM SELECT key cycles through each of the alarm limits for setting.
- If you press and hold the ALARM SELECT key while turning on the monitor, the monitor's averaging mode is changed to 8-beat SaO_2 and 8-second pulse averaging. See the *Changing the SaO_2 and pulse averaging setting* section.
- ▲ and ▼ Keys** The ▲ and ▼ keys are used to adjust up and down the following settings: alarm and alert tone volume; pulse beep volume; alarm limit settings.
- If you press and hold the ▲ key while turning on the monitor, the monitor's averaging mode is changed to 16-beat SaO_2 and 16-second pulse averaging. See the *Changing the SaO_2 and pulse averaging setting* section.
- If you press and hold the ▼ key while turning on the monitor, the monitor's averaging mode is changed to 4-beat SaO_2 and 8-second pulse averaging. See the *Changing the SaO_2 and pulse averaging setting* section.
- ALARM SILENCE Key** To silence the alarm and alert tones for two minutes, momentarily press ALARM SILENCE. To silence the alarm and alert tones indefinitely, press and hold ALARM SILENCE for about three seconds. To cancel either the two minute or the indefinite alarm silenced condition, momentarily press ALARM SILENCE.
- If you press and hold the ALARM SILENCE key while turning on the monitor, the monitor's averaging mode is changed to 16-beat SaO_2 and 8-second pulse averaging. See the *Changing the SaO_2 and pulse averaging setting* section.
- ON/OFF Key** The ON/OFF key turns on or off the monitor.

Rear Panel



**Power Supply
Connector**

The round connector from the AC charger is plugged into this connector.

Serial data connector

The serial data connector serves two purposes. The 3045 "Smart" printer connects here for printing real-time and trend data. Also, a computer or other serial device can connect here to collect patient data. See the *Using the Monitor's Serial Port* section.

**Patient cable or probe
connector**

The patient cable is usually plugged into this connector; however, the probes can be plugged directly into this connector if you don't need the extra length of the patient cable.

**Battery disconnect
switch**

Set this switch to normal when you are using the monitor. Set this switch to disconnected if you will be shipping or storing the monitor.

Operator's Maintenance

Operator's Maintenance
Schedule

When	What	How
When attaching a reusable probe to a new patient.	Clean or disinfect the reusable probe.	See <i>Clean or disinfect the reusable probes</i> on page2-5.
When LOW BATT is displayed. After the monitor is used under battery power. After shipping or long-term storage.	Charge the internal battery.	See <i>Powering the Monitor</i> on page2-2.
As necessary.	Clean or disinfect the surfaces of the monitor.	See <i>Cleaning or disinfecting the monitor</i> below.
Before shipping the monitor.	Protect internal rechargeable battery from deep discharge.	Set the rear panel battery switch to disconnected.
Before long-term storage of the monitor.	Follow long-term storage procedure.	See <i>Long term storage procedure</i> below.

Cleaning or Disinfecting
the Monitor

Clean or disinfect the surfaces of the monitor as necessary.



WARNING: Do not autoclave, ethylene oxide sterilize, or immerse the monitor in liquid. Unplug the AC charger from the device and from the wall outlet before cleaning or disinfecting.

Clean the surfaces of the monitor with a soft cloth moistened in water or a mild soap solution. If disinfection is necessary, wipe the surfaces of the monitor with isopropyl alcohol or glutaraldehyde. Then wipe with a soft, water-moistened cloth.

Long-Term Storage
Procedure

Follow this procedure if the monitor will be stored for a long period of time:

1. Set the rear panel battery switch to the disconnected position.
2. Pack the monitor and its accessories in the original packing materials and shipping carton.
3. Make sure the storage facility meets these requirements:
Facility: Indoor.
Temperature: From 4.5-43.5 °C (40-110 °F).
Humidity: Relative humidity from 10-90% (non-condensing).
Periodic inspection: None required.

Operator's Troubleshooting Guide

Problem	Possible cause	Corrective action	Page
Monitor does not turn on when front panel ON/OFF key is pressed.	Battery switch is in the disconnected position.	Move the rear panel battery switch to the normal position.	2-2
	If operating on battery power, battery may need charging.	Charge the battery.	2-2
	Internal fuse is blown.	Call your authorized service center for help.	vii
Front panel CHG indicator is not lit.	AC charger disconnected from AC outlet or from monitor.	Check the charger connections at the wall outlet and at the monitor.	2-2
	Rear panel BATTERY switch in disconnected position.	Set rear panel BATTERY switch to normal.	2-2
	AC charger defective.	Replace the charger.	
No pulse registering on the pulse bar graph. or Pulse rate erratic, intermittent, or incorrect.	Sensor or patient cable disconnected from the monitor.	Check the connections from the probe to the monitor.	2-11
	Sensor incorrectly positioned on the patient.	Reposition sensor on the patient.	2-4
	Poor patient perfusion.	Reposition sensor on the patient.	2-4
	Incorrect sensor for patient or for the application site.	Choose the correct sensor for the patient and for the application site.	2-9
	Patient motion.	Patient must remain still. Place extremity on a pillow.	
	Defective sensor or patient cable.	Replace the sensor and/or the patient cable.	

Operator's troubleshooting guide continued...

Problem	Possible cause	Corrective action	Page
	Sensor detecting ambient light	Shield sensor from light source i.e. towel, blanket.	
SaO ₂ incorrect.	Defective sensor or patient cable.	Replace the sensor and/or the patient cable.	
E0, E1, or E2 displayed.	These are internal diagnostic messages.	Call your authorized service center for help.	vii

Supplies and Accessories

3040 Oximeter Supplies and Accessories	1037	Case, Carrying	each
	1039	Case, Carrying, Double	each
	1300	Probe, Oximetry, Disp., Adult Finger	12/box
	1301	Probe, Oximetry, Disp., Ped. Finger, 15-45 Kg	12/box
	1302	Probe, Oximetry, Disp., Neonate, < 3 Kg	12/box
	1303	Probe, Oximetry, Disp., Infant, 3-15 Kg	12/box
	1606	Simulator, Oximeter/ECG	each
	2550	Bracket, Pole Mount	each
	3025	Probe, Oximetry, Wrap, Infant, 3-15 Kg	each
	3026	Probe, Oximetry, Wrap, Neonate, < 3 Kg	each
	3042	Clip, Ear (for #3043)	each
	3043	Probe, Oximetry, Universal "Y"	each
	3044	Probe, Oximetry, Finger	each
	3045	"Smart" Printer	each
	3047	Cable, Oximetry, 7 ft.	each
	3049	Strips, Adhesive	40/pkg
	3050	Manual, Operation/Service (3040)	each
	3076	Cable, Serial Interface Oximeter/Computer	each
	3078	Probe, Oximetry, Ear	each
	3134	Tape, Attachment, Neonatal	50/pkg.
	3135	Tape, Attachment, Infant	50/pkg.
	3136	Tape, Attachment, Neonatal	100/pkg.
	3137	Tape, Attachment, Infant	100/pkg.
	3138	Posey Wrap, Attachment, Universal "Y"	10/pkg
	5040	Charger, AC, 105-125v, 60 Hz	each
	5041	Charger, 230 V~, 50 Hz	each
	5042	Charger, AC, 90-110v, 50 Hz	each
3045 "Smart" Printer Supplies and Accessories	3048	Cable, Printer Interface	each
	5042	Charger, AC, 90-110v, 50 Hz	each
	5040	Charger, AC, 105-125v, 60 Hz	each
	5041	Charger, AC, 207-253v, 50 Hz	each
	3052	Manual, Operation/Service (3045)	each
	2530	Paper, Printer	4/box

Ordering Information

Contact the customer service department at the address or phone number below:

BCI International
W238 N1650 Rockwood Drive
Waukesha, WI 53188-1199

Phone: (414) 542-3100
Toll-Free: (800) 558-2345
Fax: (414) 542-0718

Chapter 3: Using the Monitor with the 3045 "Smart" Printer

Real-Time Printouts

Description	Real-time printouts require that the printer is connected to the monitor while printing. A header is printed with each real-time printout, showing the type of monitor, a space for the patient's name, and the time and date.
<i>Data Log</i>	Patient measurements are printed in alpha-numeric format at regular intervals. The intervals (1/4 min., 1/2 min., 1 to 60 min. in 1 min. increments) are chosen from the data log menu. The data log shows the current alarm settings, then prints the numeric data. Alarm settings are shown again if they are changed. The data log printout includes: SaO ₂ , pulse rate, signal strength, and minimum SaO ₂
<i>Strip Chart</i>	Patient measurements and events data are printed in a strip chart format at about 2 cm/minute. The strip chart printout includes: SaO ₂ , pulse rate, and events data.
<i>Snapshot</i>	Four seconds of the patient's plethysmogram and signal strength is printed.

Trend Printouts

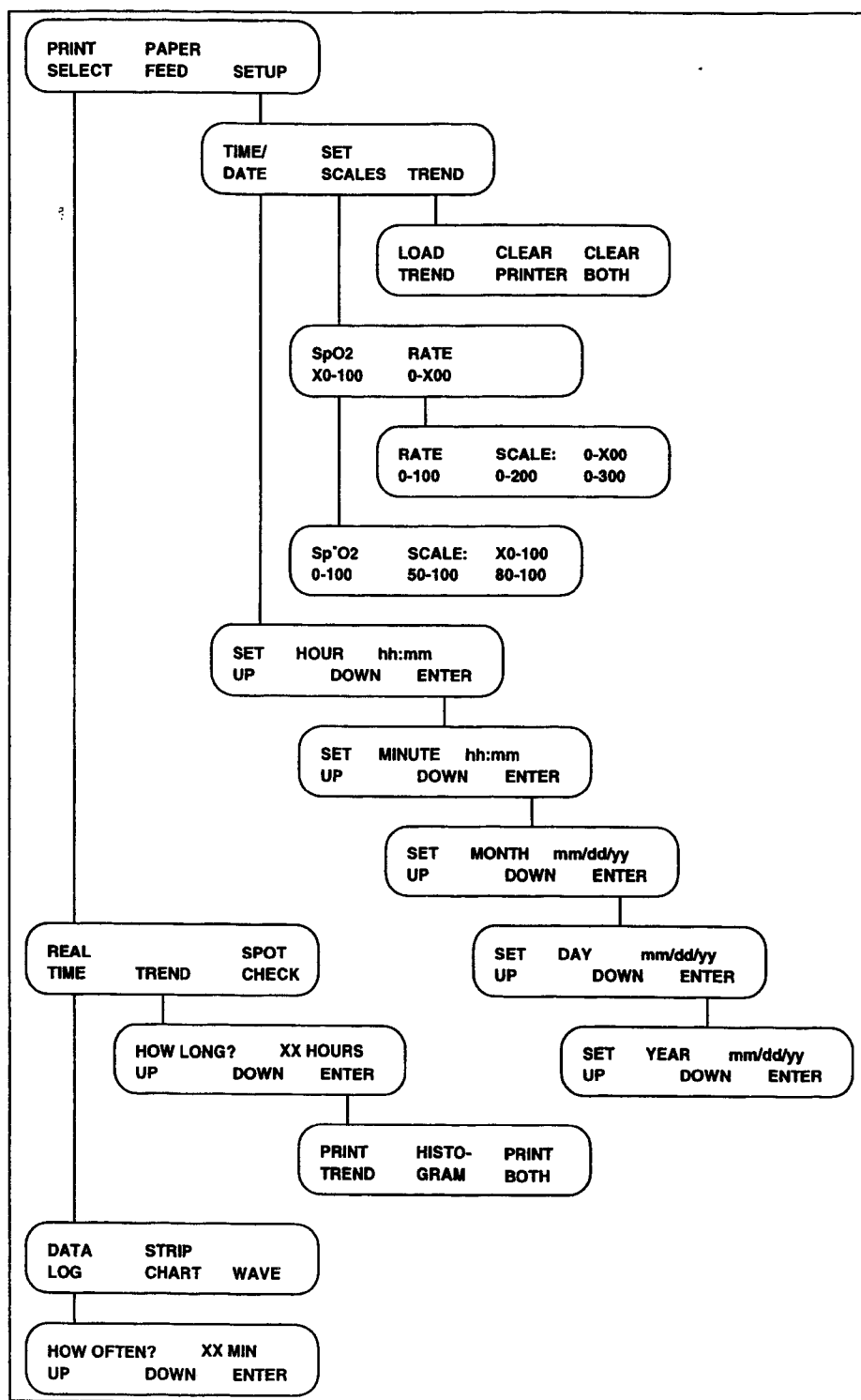
Description	The data for trend printouts comes from the printer's memory. For details on collecting and printing trends, see the <i>Collecting trend data</i> section.
<i>Trend</i>	The trend printout looks like the strip chart, except the time scale is compressed to about 0.25 cm/minute. Each line printed in the trend represents about 8 seconds. The time printed with the trend is either actual-time (trend data was collected by the printer) or relative-time (trend data was downloaded to the printer). Relative-time trend blocks always start with the time 0:00. The trend printout includes: SaO ₂ , pulse rate, and events data.
<i>Histogram</i>	The histogram shows the amount of time in minutes that a measurement (for example, SaO ₂) remained at any one value. The histogram's vertical scale shows the time in minutes, in 30-minute increments. The histogram's horizontal scale shows the measurement and its scale. Note that the histogram uses all of the trend data for the entire trend time chosen, whether the trend data is in one or more trend blocks. The histogram printout includes: SaO ₂ and pulse rate.
<i>Spot Check</i>	Measurements can be collected from several patients, then printed. For each trend block the printout shows a header and alpha-numeric values. The alpha-numeric values represent the average of up to ten valid samples from the end of each trend block. The spot check printout includes: SaO ₂ , pulse rate, signal strength.

Connecting the Monitor to the Printer

1. Turn off the printer (press the printer's ON/OFF key if necessary).
2. If AC power is available, connect the printer's AC charger to a grounded, three-wire AC outlet. Attach the round connector from the AC charger to the printer's rear panel CHARGER/POWER SUPPLY connector.
3. Set the D.C. POWER switch (on the bottom of the printer) to NORMAL OPERATION.
4. Ensure the printer's CHARGING indicator is lit.
5. Locate the data cable, catalog number 3048. Connect the female end of the data cable to the printer's rear panel SERIAL DATA connector. Connect the male end of the data cable to the monitor's rear panel SERIAL DATA connector. (There is only one connector on the monitor that will mate with the printer's data cable.) Press firmly on both ends of the cable to securely seat the connectors.
6. Turn on the printer (press the printer's ON/OFF key).
7. Momentarily press the printer's PAPER FEED key to ensure the printer paper is properly loaded. If no printer paper comes out of the slot on the top of the printer, or if there is a red stripe on the paper, see in the 3045 Printer's Operation/Service manual: *Replacing the Printer Paper* in the *Operator's Maintenance* section.
8. The printer is now ready to print real-time data from the monitor, collect trend data from the monitor, or receive downloaded trends from the monitor.

Printer Menu

Refer to this illustration when changing the scale settings, choosing real-time printouts, or choosing trend printouts.



Setting the Printer's
Time and Date

For information on setting the printer's time and date, see *Printer Clock and Calendar* in the 3045 "Smart" Printer Operation/Service manual.

Scale Settings

The strip chart, trend, and histogram printouts use the printer's SaO₂ and Rate scale settings when printing. Follow these steps to view or change either the SaO₂ or Rate scale settings:

Procedure for Setting Print Scales

1. Connect the monitor to the printer as previously described.
2. Turn on the monitor and the printer. All of the following steps are performed at the printer.
3. Press SETUP.
4. Press SET SCALES. The current SaO₂ scale setting is shown on the left side of the display. The current Rate scale setting is shown in the middle of the display.
5. To change the SaO₂ scale setting, press the menu key beneath the SaO₂ scale setting.
 - 5.1. Press the key beneath the desired setting (0-100, 50-100, or 80-100). The current SaO₂ scale setting is shown in the upper-right portion of the display.
 - 5.2. When the desired setting is shown, press the EXIT key.
6. To change the Rate scale setting, press the menu key beneath the Rate scale setting.
 - 6.1. Press the key beneath the desired setting (0-100, 0-200, or 0-300). The current Rate scale setting is shown in the upper-right portion of the display.
 - 6.2. When the desired setting is shown, press EXIT.
7. Press EXIT twice to return to the main menu.

Real-time printouts

Real-time printouts require that the printer is connected to the monitor while printing. Descriptions, instructions, and sample printouts follow.

Data Log Printout

The patient's measured values are printed at regular intervals. The current alarm settings are printed first, then the numeric data is printed at the chosen interval. Alarm settings are printed again if they are changed. Asterisks (***) indicate invalid or unavailable data.

Printing Instructions

1. Connect the monitor to the printer.
2. Turn on the printer and the monitor.
3. At the printer, press PRINT SELECT.
4. Press REAL TIME.
5. Press DATA LOG.
6. The data log interval setting is shown on the right side of the display. To change the setting, press UP or DOWN. The settings are 1/4 minute, 1/2 minute, or 1 minute to 60 minutes in 1 minute increments.
7. When the desired data log interval time is shown, press ENTER.
8. The actual time when the measurements were taken is printed with each data log.
9. The data log continues until stopped. Press STOP PRINT to stop the printout.

SAMPLE PRINTOUT:
DATA LOG

BCI International 3040 Oximeter

Patient ID
Date 1/21/88 Time 13:19

DATA LOG

SaO2 High = 100
SaO2 Low = 79
Pulse Rate High = 130
Pulse Rate Low = 45

Time 13:19:32

SaO2 = 97
PULSE RATE = 98
Signal Strength = 6
Minimum SaO2 = 97

Time 13:19:47

SaO2 = 97
PULSE RATE = 98
Signal Strength = 6
Minimum SaO2 = 97

Time 13:20:02

SaO2 = 97
PULSE RATE = 89
Signal Strength = 6
Minimum SaO2 = 97

Time 13:20:17

SaO2 = 98
PULSE RATE = 88
Signal Strength = 6
Minimum SaO2 = 97

Time 13:20:32

SaO2 = 97
PULSE RATE = 89
Signal Strength = 6
Minimum SaO2 = 97

Time 13:20:47

SaO2 = 97
PULSE RATE = 92
Signal Strength = 6
Minimum SaO2 = 97

Strip Chart Printout

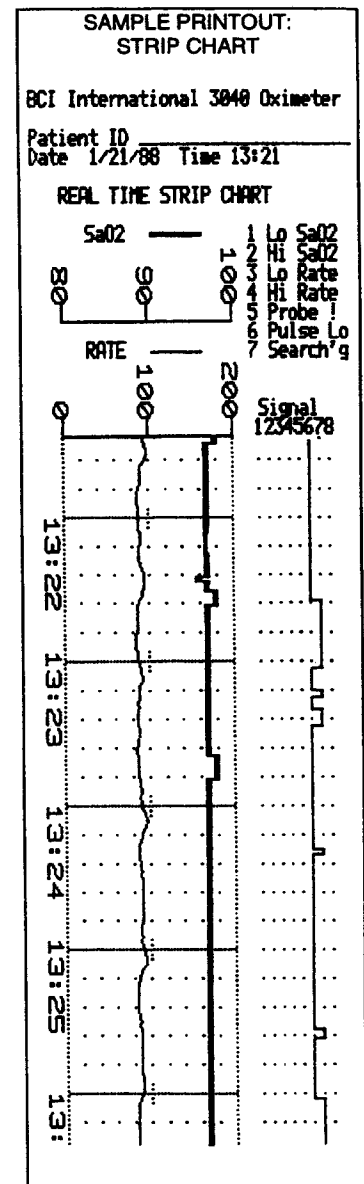
The patient's measured values and events data is printed in a strip chart format at about 2 cm/minute. Each dot along the strip chart represents about one second.

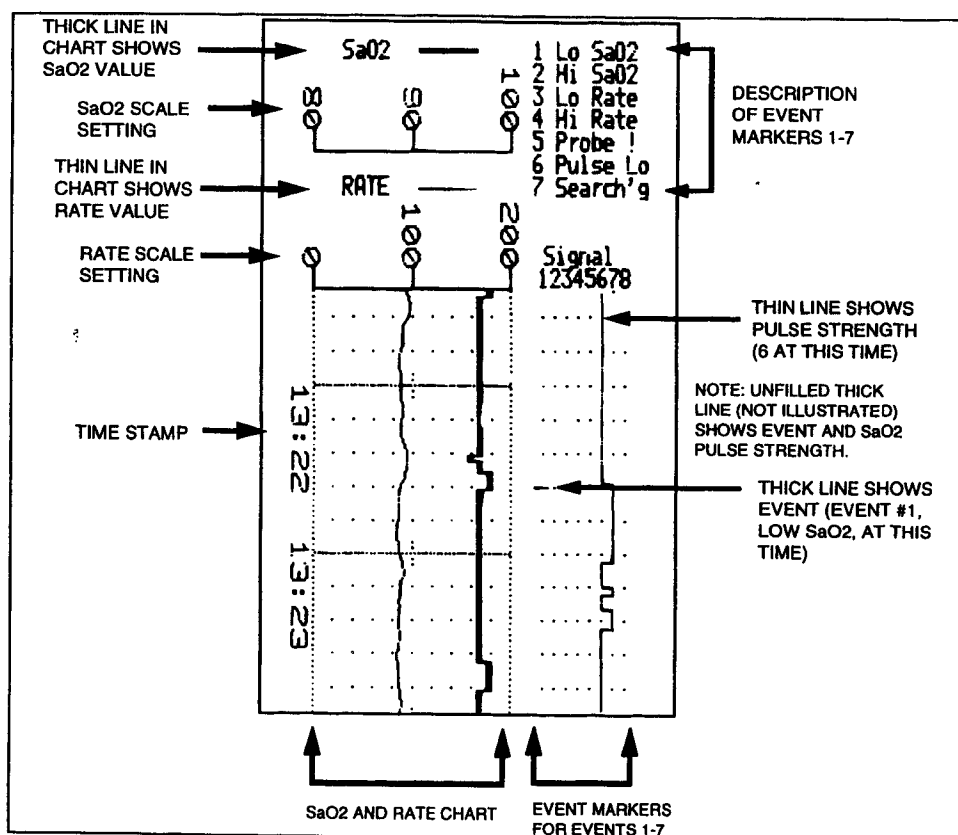
Notice the header shows the print scale and the width of the lines representing the SaO_2 value and the pulse rate value. In the sample printout, the SaO_2 scale is 0-100% SaO_2 and the pulse rate scale is 0-100 beats per minute.

The pulse signal strength and events markers are printed above the measured SaO_2 and pulse rate values. A thick line on the events marker indicates an event; a thin line on the events marker indicates the pulse signal strength. A detailed example of strip chart and trend events markers follows this description.

Printing Instructions

1. Connect the monitor to the printer.
2. Turn on the printer and the monitor.
3. At the printer, press PRINT SELECT.
4. Press REAL TIME.
5. Press STRIP CHART.
6. The strip chart will continue to print until stopped. Press STOP PRINT to stop the strip chart printout.



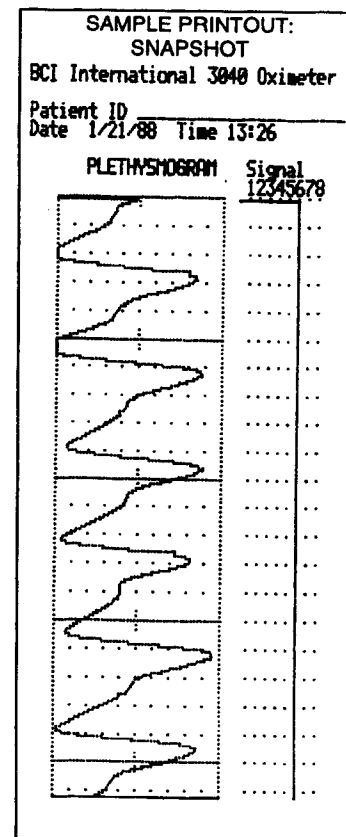
*Strip Chart and Trend
Events Markers*

Snapshot Printout

Four seconds of the patient's current plethysmogram and signal strength is printed.

Printing Instructions

1. Connect the monitor to the printer.
2. Turn on the printer and the monitor.
3. At the printer, press PRINT SELECT.
4. Press REAL TIME.
5. Press PLETH.
6. Four seconds of the patient's current plethysmogram is printed.



Trend Printouts

Description

The data for trend printouts (trend, histogram, and spot check) comes from the printer's memory. Therefore, trend printouts require that the data is either *collected* by the printer or *collected* by the monitor then *downloaded* to the printer. Trend data is collected by the printer whenever the printer is attached to the monitor and the printer is turned on. Trend data is collected by the monitor whenever the monitor is turned on. Trend data is downloaded from the monitor by connecting the printer to the monitor then choosing load trend at the printer.

Trend data is collected in *blocks*. A block of trend data starts when the device collecting the trend data is turned on, and ends when the device collecting the trend data is turned off.

The amount of time used for trend printouts, from 1 to 9 hours in 1 hour increments, is chosen before printing the trend. A header is printed with each trend printout, showing the type of monitor, a space for the patient's name, and the time and date.

The printer relies on its internal clock and calendar when collecting, downloading, and printing trend data. Because of this, it's important to check the printer's time and date settings *before* collecting or downloading important trend data to the printer. Also, real-time printouts are time-stamped according to the printer's clock and calendar setting.

When you collect or download trend data to the printer, the trend data is correlated to the time and date when collected or downloaded. If you then change the printer's time or date setting, the data collected or downloaded "moves" to its appropriate location in the printer's 9-hour trend "window". For example, if you download 9 hours of trend data, then change the printer's clock to one hour later, you will "lose" 1 hour of trend data. See in the 3045 "Smart" Printer Operation/Service manual *Printer Clock and Calendar* for instructions on setting the printer's clock.

The way trends are collected, by the printer or by the monitor, affects the trend printouts. The main difference is that trends collected by the printer are time-stamped with the actual time the trends were collected; trends collected by the monitor are not time-stamped with the actual time the trends were collected. For details about how the printer's and monitor's trend data is handled, see the *Trend Reference Information* section.

Collecting Trend Data

Whether you collect trends in the printer or in the monitor depends on the type of trend printout you want.

Trend If you want a trend printout with the actual time and date stamped on the printout, you'll want to collect trends in the printer. If it doesn't matter whether the trend printout has the actual time or a relative time stamped on the printout, you can collect trends in the printer or in the monitor.

Histogram If you want to print a histogram, you can collect trends in the printer or in the monitor. The histogram feature calculates the histogram for the entire trend time you choose, even if the data is in more than one trend block. If you want to print histograms for a specific patient, you'll want to first clear trends in the device collecting the patient's data. This will ensure that the histogram printout represents only one patient.

Spot Check If you want spot check printouts, you'll want to collect trends in the monitor. You'll also want to clear the monitor's trends before you start to collect spot check data from several patients, but not between patients. Spot check prints data for each trend block. That means if the monitor is turned on (for more than one minute) then off 10 times, 10 trend blocks will produce 10 spot check printouts.

Procedures for collecting trends in the printer or in the monitor follow.

*Procedure For
Collecting Trends in
the Printer*

1. Connect the printer to the monitor as previously described.
2. Attach the patient to the monitor.
3. Turn on the printer and the monitor.
4. If you've previously collected trend data in the printer that you want to print, skip this step and do not clear the printer's trends. If you want the printer's trend memory to have only data from the current patient, clear the printer's trends by doing the following to the printer:
 - 4.1. From the printer's main menu, press SETUP, then press TREND, then press CLEAR PRINTER.
5. The patient's measured values are collected by the printer. After you've collected trends for this patient, you can print the trends or collect trend data for another patient.
6. If you're collecting trend data for another patient, turn off the printer to end the patient's trend block. Then repeat the steps above but don't clear the printer's trends. Remember, each time you turn on the printer you start a new trend block. Each time you turn off the printer you end the trend block.
7. Trends are printed the same way, whether they are collected by the printer or collected by the monitor and downloaded to the printer. When you print trends, all trend blocks are printed for the trend time you choose. When you print a histogram, the printout will show histogram data for the entire trend time you choose, even if the data is in more than one trend block. When you print spot check data, one block of measurements will print for each trend block collected.

*Procedure For
Collecting Trends in
the Monitor*

1. If you've previously collected trend data in the monitor that you want to download and print later, skip this step and do not clear the monitor's trends. If you want the monitor's trend memory to have only data from the current patient, clear the monitor's trends by doing the following:
 - 1.1. Connect the printer to the monitor as previously described and turn on the printer and the monitor. From the printer's main menu, press SETUP, then press TREND, then press CLEAR BOTH, then press YES. Disconnect the printer from the monitor.
2. Turn off the monitor.
3. Attach the patient to the monitor.
4. Turn on the monitor.
5. The patient's measured values are collected by the monitor. After you've collected trends for this patient, turn off the monitor.
6. If you're collecting trend data for more than one patient, repeat the steps above but don't clear the monitor's trends. Remember, each time you turn on the monitor you start a new trend block. This trend block is *current* until the monitor is turned off. When the monitor is turned off, the current trend block is ended.
7. After you've collected trend data and you're ready to print the trends, download the monitor's trend data as follows:
8. Connect the printer to the monitor as previously described. Turn on the printer and the monitor. From the printer's main menu, press SETUP, then press TREND, then press LOAD TREND.
9. Trends are printed the same way, whether they are collected by the printer or collected by the monitor and downloaded to the printer. When you print trends, all trend blocks are printed for the trend time you choose. When you print a histogram, the printout will show histogram data for the entire trend time you choose. When you print spot check, one block of values will print for each trend block.

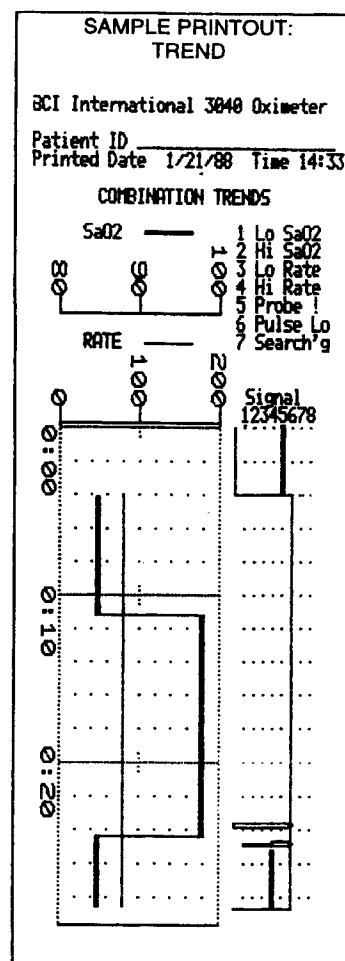
Trend Printout

The trend printout looks like the strip chart, except the time scale is compressed to about 0.25 cm/minute. Each dot represents about 8 seconds. The time printed with the trend is either actual-time (trend data was collected by the printer) or relative-time (trend data was downloaded to the printer, trend blocks start at 0:00).

The headers and events markers are the same as for the strip chart printout. See the *Strip chart and trend events markers* section.

Printing Instructions

1. Collect trend data in the printer or monitor as previously described.
2. If trends were collected in the monitor, download the trends to the printer as previously described.
3. At the printer, press PRINT SELECT.
4. Press TREND.
5. Press UP or DOWN to choose the number of hours, from 1 to 9, you want the trend printout to show (from current time backwards). Then press ENTER.
6. To print the trend only, press PRINT TREND. To print both the trend and histogram, press PRINT BOTH.
7. Each trend block for the entire trend time chosen will be printed. The oldest trend block is printed first, and the newest trend block is printed last. The printout stops after all trends for the trend time chosen have been printed. To stop the printout, press STOP PRINT.

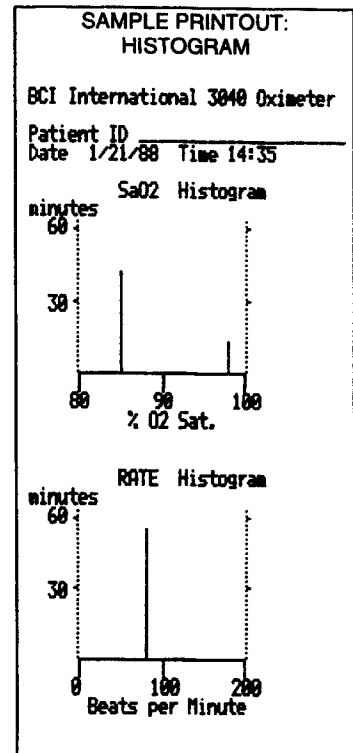


Histogram Printout

The histogram shows the amount of time in minutes that a measurement (for example, SaO_2) remained at any one value. The histogram's vertical scale shows the time in minutes, in 30-minute increments. The histogram's horizontal scale shows the measurement and its scale.

Printing Instructions

1. Collect trend data in the printer or monitor as previously described.
2. If trends were collected in the monitor, download the trends to the printer as previously described.
3. At the printer, press PRINT SELECT.
4. Press TREND.
5. Choose the number of hours, from 1 to 9, you want the histogram printout to show (from current time backwards). Press UP or DOWN to change the number of hours. When you've set the desired number of hours for the trend printout, press ENTER. Remember, the histogram feature calculates the histogram for the entire trend time you choose, even if the data is in more than one trend block.
6. To print the histogram only, press HISTOGRAM. To print both the trend and histogram, press PRINT BOTH.
7. The printer uses all trend data for the trend time specified to calculate the histogram printout. To stop the printout, press STOP PRINT.



Spot Check Printout

Spot check prints a block of alpha-numeric values for each trend block collected.

For each trend block, spot check starts with the newest trend sample and goes backwards in the trend block, looking for up to ten *valid samples*. (A valid sample is a sample stored when SaO_2 and rate values are displayed, and the "PULSE SEARCH" message is not active.) If one to ten valid samples are found, the values are averaged and printed.

If spot check cannot find at least one valid sample in the trend block, then "NO DATA" is printed. "LOW PULSE" is printed if any of the samples used were stored while that message was active.

Printing Instructions

1. Clear the monitor's trends as previously described.
2. Collect trend data in the monitor as previously described. For each patient, turn on the monitor and collect data for at least one minute. Then turn off the monitor and go on to the next patient. Do not clear the trends.
3. After you've collected data for each patient, connect the printer to the monitor as previously described.
4. At the printer, press PRINT SELECT.
5. Press SPOT CHECK. The monitor's trend data is downloaded to the printer, then spot check values are printed for each trend block.
6. Values for the newest trend block are printed first; values for the oldest trend block are printed last. The time printed with spot check shows the time the data was *printed*, not the time the data was *collected*.

SAMPLE PRINTOUT: SPOT CHECK BCI International 3040 Oximeter Patient ID _____ Printed Date 1/21/88 Time 13:55 SPOT CHECK LOW PULSE $\text{SaO}_2 = 98$ PULSE RATE = 80 Signal Strength = 6 BCI International 3040 Oximeter Patient ID _____ Printed Date 1/21/88 Time 13:55 SPOT CHECK NO DATA BCI International 3040 Oximeter Patient ID _____ Printed Date 1/21/88 Time 13:55 SPOT CHECK NO DATA BCI International 3040 Oximeter Patient ID _____ Printed Date 1/21/88 Time 13:55 SPOT CHECK NO DATA
--

Trend Reference Information

Trends Collected by the Printer

- Up to 9 *calendar* hours of trend data (SaO₂, pulse rate, signal strength, and events information) is automatically collected and stored in the printer's memory for trend, histogram, or spot check printouts. When trend data is collected by the printer, trend data does not need to be downloaded from the monitor to the printer.
- The printer's trend memory is *non-volatile*; that is, trend data stored in the printer's memory is retained after it is turned off.
- As soon as the printer is turned on, a new trend block is started. When the printer is turned off, the trend block is ended. The printer collects a trend block for each period of time it is on, for up to 9 *calendar* hours of trend data total. Note that trend blocks that represent less than one minute are not printed.
- Example of calendar hours: If an 8-hour trend block is collected, then the printer is turned off for a 2-hour period, then a 1-hour trend block is collected, there are two trend blocks in the printer. The older trend block is 6 hours long, then there is a 2 hour "break" in the trend data (no data will be printed), then the newer trend block is 1 hour long. The newest data always replaces the oldest data.
- Trends collected by the printer are time-stamped with the actual time they were collected. (Trends collected by the printer are simultaneously collected by the monitor; however, the trend data in the monitor is not time-stamped.)
- The printer's trend memory is cleared one of three ways:
 - When CLEAR PRINTER or CLEAR BOTH is chosen in the printer's setup - trend menu.
 - When LOAD TREND is chosen in the printer's setup - trend menu. (First, the printer's entire trend memory is erased. Then, the monitor's trend data is downloaded to the printer.)
 - When SPOT CHECK is chosen in the printer's print select menu.

Trends Collected by the Monitor

- Up to 9 hours of trend data (SaO₂, pulse rate, signal strength, and events information) is automatically collected and stored in the monitor's memory for trend, histogram, or spot check printouts.
- The monitor's trend memory is *non-volatile*; that is, trend data stored in the monitor's memory is retained after it is turned off.
- As soon as the monitor is turned on, a new trend block is started. This trend block is *current* until the monitor is turned off. When the monitor is turned off, the current trend block is ended. The monitor collects a trend block for each period of time it is on, for up to 9 hours of trend data total. If more than 9 hours of trend data is collected, the newest data always replaces the oldest data. Note that trend blocks that represent less than one minute are not printed.
- For example, if 8 hours of trend data is collected, then the monitor is turned off for 2 hours, then 2 hours of trend data is collected, there are two trend blocks in the monitor. The older trend block is 7 hours long, and the newer trend block is 2 hours long. The newest data always replaces the oldest data.
- When the monitor's trend data is downloaded to the printer, each trend block printed starts with the time at 0:00. Trends starting at 0:00 are *relative-time* trends; that is, the time shown on the trend printout is relative to its start at 0:00. (The monitor does not mark the trend blocks with the time and date, so the printer does not know when the trend blocks started.)
- If data is downloaded to the printer while the monitor has a current trend block (that is, the monitor was not turned off before the printer was connected and the trend data was downloaded), then the current trend block will print with the actual time.
- The monitor's trend memory is cleared by choosing CLEAR PRINTER in the printer's setup - trend menu.

Clearing Trends

Depending on the type of trend printout desired, you may want to clear the printer's or monitor's trend memory.

Reasons to Clear the Trend Memory

You'll want to clear the printer's or monitor's trend memory if you'll be printing histograms for a specific patient. The histogram feature uses all trend data for the amount of trend time you specify, even if the trend data is in more than one trend block.

You'll want to clear the monitor's trends before you start to collect spot check data from several patients, but not between patients. Spot check prints data for each trend block. That means if the monitor is turned on (for more than one minute) then off 10 times, 10 trend blocks will produce 10 spot check printouts.

To Clear the Printer's Trend Memory

1. The following steps are performed at the printer.
2. From the main menu, press SETUP.
3. Press TREND.
4. Press CLEAR PRINTER.

To Clear the Monitor's Trend Memory

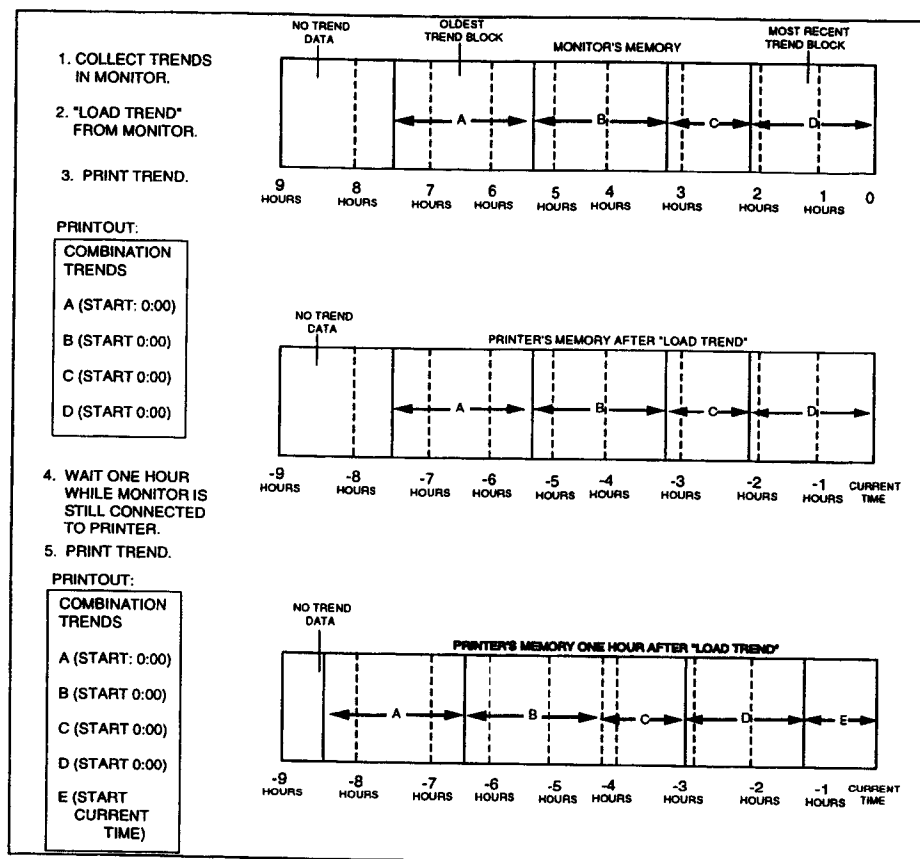
1. Connect the printer to the monitor as previously described.
2. The following steps are performed at the printer.
3. From the main menu, press SETUP.
4. Press TREND.
5. Press CLEAR BOTH.
6. Press YES.

Downloading Trends

If you've collected trends in the monitor, you'll need to download the monitor's trend memory to the printer before printing trends. Remember that trends downloaded from the monitor to the printer are relative-time; each trend block starts at 0:00 and the time on the trend printout is marked relative to 0:00.

The following illustration shows an example of the monitor's trend memory and the printer's trend memory after trends are downloaded. Downloading trends from the monitor to the printer first erases the printer's entire trend memory, then the monitor's trends are downloaded to the printer. Note that downloading trends does not erase the trends in the monitor. Trend data remains in the monitor until CLEAR BOTH is chosen in the printer's setup - trend menu.

Trends Downloaded from the Monitor to the Printer



To Download Trends from the Monitor to the Printer

1. Connect the printer to the monitor as previously described.
2. Turn on the printer and the monitor.
3. All of the following steps are performed at the printer.
4. From the main menu, press SETUP.
5. Press TREND.
6. Press LOAD TREND. First, the printer's entire trend memory is erased. Then, the monitor's trend data is downloaded to the printer.

Chapter 4: Using the Monitor's Serial Port

This chapter provides a technical description of the monitor's serial port and communication protocols. These topics are covered:

- The serial port's two operating modes.
- The serial port's connector pinout and electrical characteristics.
- The communication protocol (baud rate, etc.)
- Details for using the data line mode.
- Details for using the printer mode.

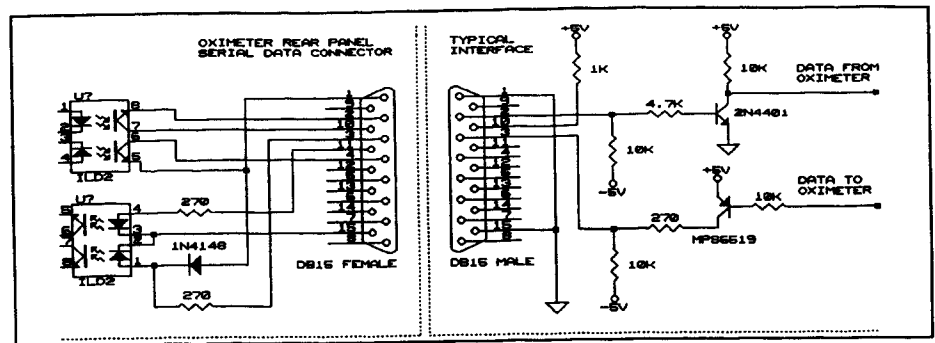
NOTE: The 3045 "Smart" printer automatically implements the hardware and software protocols detailed in this chapter. For information on using the 3045 "Smart" printer with the monitor, see the *Using the Monitor with the 3045 "Smart" Printer* section.

Serial Port Operating Modes

Description	The monitor's rear panel SERIAL DATA connector is a bi-directional serial port that operates in one of two modes: data line mode or printer mode. In the data line mode, the monitor sends a 26-byte ASCII string every second; no handshaking protocols are used. In the printer mode, the monitor sends data in response to single byte commands from the host. (Note that the printer mode was designed for use with the 3045 "Smart" printer, but is available to any host that supports the printer mode command and response handshaking protocols.)
Choosing the Operating Mode	If the monitor's serial port receives from the host the handshaking protocol required for the printer mode, then the serial port operates in the printer mode. Otherwise, the serial port operates in the data line mode.
<i>Choosing the Printer Mode Example</i>	If you connect the 3045 "Smart" printer to the monitor, the 3045 printer sends single-byte commands to the monitor, and then responds to the monitor with the correct handshaking. In this case, the 3045 acts as the host in communicating with the monitor.
<i>Choosing the Data Line Mode Example</i>	If you connect a computer's serial port to the monitor and only receive data from the monitor, then the monitor's serial port operates in the data line mode.

SERIAL DATA Connector Pinout and Interface

SERIAL DATA Connector Pinout and Interface Schematic



Interface Hardware Description

The pins on the SERIAL DATA connector are electrically isolated from the rest of the monitor's circuitry. For this reason, a special interface circuit, external to the monitor, is required when connecting the monitor to an external device. This interface circuit converts the monitor's electrically isolated inputs/outputs to voltage levels that are compatible with most RS232 interfaces.

NOTE: This interface is available as an option, called the CABLE, SERIAL INTERFACE OXIMETER/COMPUTER. It consists of a cable with two connectors on each end: a DB15 that connects to the monitor and a DB25 that connects to an RS232 interface. A single 9 volt transistor battery supplies power for the interface; the interface circuitry is built into the cable. For ordering information, see the *Supplies and Accessories* section.

Communication Protocol

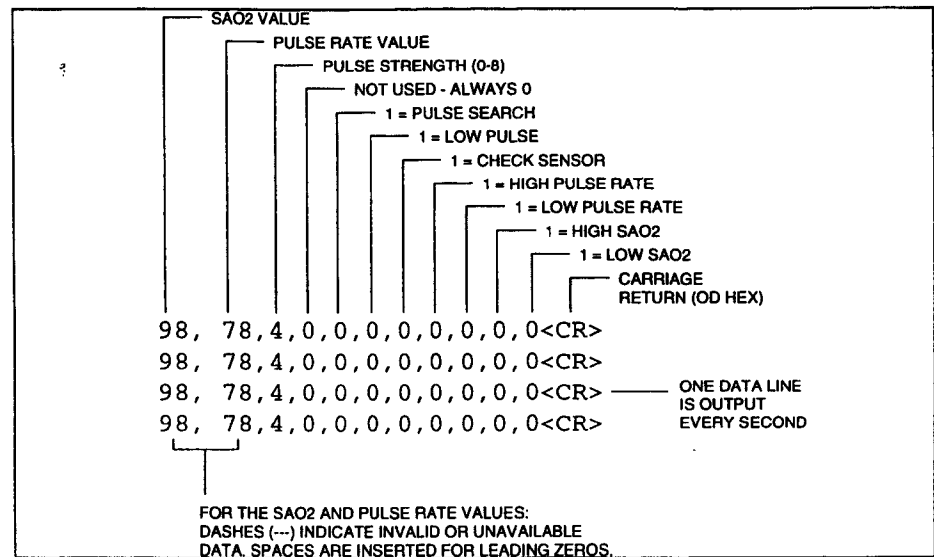
The serial port communication protocol is the same for both the data line and the printer modes. The communication protocol is:

- 4800 baud
- 1 start bit
- 8 data bits
- ODD parity bit
- 1 stop bit

Data Line Mode

In the data line mode, the monitor sends SaO₂, pulse rate, pulse strength, and events data. The data is sent as a 26-byte ASCII character string, terminated with a carriage return (CR). No handshaking protocols are used; the monitor sends the data string once every second. The ASCII data string contains the following measurements and events in the order shown.

Data Line Mode Sample Output



Printer Mode

General Description

The host controls the data output from the monitor by sending single-byte commands to the monitor.

Send a RESET and a BEGIN command to the monitor if either a RESET command was the last command sent or if no data has been received from the monitor for 2 seconds. Do not send any commands after BEGIN until the OK response is received. Repeat the RESET/BEGIN command sequence if OK is not received within one second of RESET/BEGIN.

The CONFIG command (I) and the "i" response data are used by the host.

The basic DATA response is sent by the monitor once a second after the initial responses to the BEGIN command. The SETTINGS response is sent whenever the alarm limits are changed or the SETUP command is issued. Response to the REALTM or the HISTORY command causes both of these commands to be ignored until the response has been completed or is terminated. DATA responses are inhibited during a HISTORY dump, but resume immediately after (allowing the current block of data to continue with new data).

Commands and Response Formats

Commands are sent from the host to the monitor, and responses are sent from the monitor to the host. Commands and response identifiers (lead character in a string of data) are sent as the ASCII code for the shown letter, with the seventh bit set to 1. Data is less than 127; 127 represents unusable (invalid or unavailable) data. Information requiring counts greater than 126 are sent in L (low) and H (high) nibbles. Nibbles are sent high nibble first, low nibble last.

Commands

Commands	ASCII	Response(s)
RESET	A	All transmissions from the monitor are halted. Only BEGIN command generates a response.
BEGIN	B	OK then SETTINGS then DATA. After the first response, DATA is sent once a second and SETTINGS is sent when changes occur.
SETUP	C	SETTINGS.
REALTM	D	LOWRES is sent when the signal level changes. WAVE (plethysmogram) is sent at 60 Hz rate.
STOPREALTM	E	REALTM mode halted; LOWRES and WAVE responses inhibited.
STOPHIST	F	HISTORY dump halted; HEADER and HDATA responses stopped.
CLEARHIST	G	History data collection restarted (old data ignored).
HISTORY	H	HEADER and HDATA
CONFIG	I	See CONFIG under Responses Description
LOG	J	Oximeter resets MinSaO ₂ detection.

Responses

Responses	ASCII	Description																		
OK	g	20 = identifying code for 3040 Oximeter.																		
SETTINGS	b	LoSaO ₂ , HiSaO ₂ , LoRateH, LoRateL, HiRateH, HiRateL.																		
DATA	a	SaO ₂ , RateH, RateL, SignalLevel, Events, MinSaO ₂ .																		
SIGLEVEL	d	SignalLevel. The SignalLevel is a signal strength indication where each count (0-8) represents a doubling of the average pulse height. It is used to scale the PlethData with each count representing halving of the gain applied to the normalized infrared signal.																		
WAVE	c	PlethData. Normalized plethysmogram signal, 0-99 counts, with 50 counts representing DC level.																		
HEADER	f	#SamplesH, #SamplesM, #SamplesL. Note: #SamplesX = 127 except for a current block of data where the number may be used to calculate back from current time so the presentation may have clock time annotation.																		
HDATA	e	SaO ₂ , RateH, RateL, SignalLevel, Events. <table><tr><th>Bit</th><th>Events</th></tr><tr><td>Bit 0</td><td>not used</td></tr><tr><td>Bit 1</td><td>SaO₂ alarm</td></tr><tr><td>Bit 2</td><td>pulse rate alarm</td></tr><tr><td>Bit 3</td><td>not used</td></tr><tr><td>Bit 4</td><td>probe problem</td></tr><tr><td>Bit 5</td><td>low signal (perfusion)</td></tr><tr><td>Bit 6</td><td>searching for pulse</td></tr><tr><td>Bit 7</td><td>must be 0, this is a data byte</td></tr></table>	Bit	Events	Bit 0	not used	Bit 1	SaO ₂ alarm	Bit 2	pulse rate alarm	Bit 3	not used	Bit 4	probe problem	Bit 5	low signal (perfusion)	Bit 6	searching for pulse	Bit 7	must be 0, this is a data byte
Bit	Events																			
Bit 0	not used																			
Bit 1	SaO ₂ alarm																			
Bit 2	pulse rate alarm																			
Bit 3	not used																			
Bit 4	probe problem																			
Bit 5	low signal (perfusion)																			
Bit 6	searching for pulse																			
Bit 7	must be 0, this is a data byte																			

Chapter 5: Product Specifications

Display	LCD with electroluminescent backlight. Large digital display of SaO_2 and pulse rate. Continuous display of high and low alarm limits and pulse bar graph.
SaO_2	Averaging: User-selectable 4, 8, or 16 beat average. Range: 0-100% SaO_2 Accuracy: $\pm 2\%$ at 70-100% $\pm 3\%$ at 50-69% Alarm ranges: Low: 50-99% and off, in 1% steps High: 50-100% and off, in 1% steps
Pulse Rate	Averaging: User-selectable 8 or 16 second pulse average Range: 30-254 BPM Accuracy: $\pm 2\%$ at 30-250 BPM Alarm ranges: Low: 5-195 and off, in 5 BPM steps High: 5-250 and off, in 5 BPM steps
Alarm Indicators	Two-tone audible alarm with user-adjustable volume and two-minute or indefinite alarm silence. Flashing red LED indicator.
Alert Indicators	Single-tone double beep with the same volume and silence as the alarm tone. Steady red LED indicator. Alerts include: CHECK SENSOR; PULSE SEARCH.
Messages	Message displayed on screen. Messages include: LOW PULSE; LOW BATT; ALARM SILENCED; BEEP; BEEP SILENCED; ALARM.
Compliance	UL 544 Listed IEC-601-1 TUV Certified (The TUV license applies to the 3040/3045 and charger, catalog number 5041, 230 V~, 50 Hz input.)
Serial inputs/outputs	Data Line Mode: Default mode sends SaO_2 , pulse rate, and events data in a comma delimited string, terminated with a carriage return. Printer mode: SaO_2 , pulse rate, signal strength, plethysmogram, status indication, alarm settings, and trend data sent in response to single character commands.
Power Requirements	AC input: 115 V~, 60 Hz, 25 mA 230 V~, 50 Hz (optional) 90-110 V~, 50 Hz (optional) Battery: Internal sealed lead-acid battery provides 12 to 16 hour operation with 10 hour charge time.
Physical	Height: 7.11 cm (2.8 in.); Width: 14.73 cm (5.8 in.); Depth: 19.05 cm (7.5 in.) Weight: 1.0 Kg (2.25 lbs.)

CONFIG Command CONFIG command: I
Response: (see chart below)

Item	# & type	ASCII in "quotes", decimal in (parenthesis)
i	1 ascii+128	(233)
Product	20 binary	(1)
Flag	1	(7)
Header	32 ascii	"BCI International 3040 Oximeter"
Event1	8 ascii	"Lo SaO ₂ "
Event2	8 ascii	"Hi SaO ₂ "
Event3	8 ascii	"Lo Rate "
Event4	8 ascii	"Hi Rate "
Event5	8 ascii	"Probe ! "
Event6	8 ascii	"Pulse Lo"
Event7	8 ascii	"Search'g"
SnapS	6 ascii	" PLETH"
SnapL	16 ascii	" PLETHYSMOGRAM "
SnapBot	3 ascii	" "
SnapMid	3 ascii	" "
SnapTop	3 ascii	" "
Label1-8	8 ascii	" Signal "
Label1S	6 ascii	" SaO ₂ "
Label1L	16 ascii	" SaO ₂ "
Units1	16 ascii	" % O ₂ Sat. "
Bytes1	1 binary	(1)
Range11	19	"0-100 " " 0" " 50" "100" (0) (1) (1) (0)
Range12	19	"80-100" " 80" " 90" "100" (80) (5) (1) (0)
Range13	19	"50-100" " 50" " 75" "100" (50) (2) (1) (0)
Label2S	6 ascii	" RATE "
Label2L	16 ascii	" PULSE RATE"
Units2	16 ascii	"Beats per Minute"
Bytes2	1 binary	(2)
Range21	19	"0-100 " " 0" " 50" "100" (0) (1) (1) (0)
Range22	19	"0-200 " " 0" "100" "200" (0) (1) (2) (0)
Range23	19	"0-300 " " 0" "150" "300" (0) (1) (3) (0)
Label3	16 ascii	" Signal Level"
Bytes3	1 binary	(1)
Label4	16 ascii	" Minimum SaO ₂ "
Bytes4	1 binary	(1)
Set1	16 ascii	" SaO ₂ Low"
Set1#	1 binary	(1)
Set2	16 ascii	" SaO ₂ High"
Set2#	1 binary	(1)
Set3	16 ascii	" Pulse Rate Low"
Set3#	1 binary	(2)
Set4	16 ascii	" Pulse Rate High"
Set4#	1 binary	(2)
Set5	16 ascii	" "
Set5#	1 binary	(0)
Set6	16 ascii	" "
Set6#	1 binary	(0)
Set7	16 ascii	" "
Set7#	1 binary	(0)
Set8	16 ascii	" "
Set8#	1 binary	(0)